AD 659511

FINAL REPORT

VALUE ENGINEERING

Project 2A-2

8 May 1963

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SUMMARY

Value engineering is an effective cost reduction tool when accurately defined and when enough effort is devoted to it. In its present state of definition and development in the DOD industry complex, however, value engineering is falling far short of its potential. Value engineering is currently producing savings at an annual rate of approximately $60 million while its potential is many times that amount.

There are two main reasons why value engineering is not achieving anywhere near its full potential. First, value engineering is currently being applied on a limited basis. Of the one hundred largest defense contractors, only about half have value engineering programs. Many of these programs are narrowly defined and seriously understaffed. Less than 500 full-time value engineers are currently employed in the DOD and defense industry, while a minimum number required to do a thorough job is estimated at 2,500. The result is that less than 20% of the total number of sub-systems and components being developed and produced are subjected to a real value engineering analysis. Second, value engineering as it is presently defined and used suffers from a number of deficiencies which inhibit the achievement of optimum cost reductions in defense products. Among the more serious flaws in value engineering as it is presently employed in the DOD and defense industry are:

- There is no body of systematic criteria for the priority selection of items to be value engineered;

- There is no well-defined and precise methodology covering the "how" of getting maximum return on those items which are subjected to value engineering;

- Management has not been given enough information about value engineering to be able to provide adequate top level support of the function;

- The DOD has not been willing to put enough dollar incentives in its contracts to pay for contractors' efforts on value engineering; and

- Training programs are insufficient to provide the quantity and quality of professional value engineers required to enable value engireering to obtain its full potential.

In order to achieve the full savings potential from the application of the value engineering technique to defense products, it will be necessary to:

- Improve the state-of-the-art of value engineering in order to maximize the achievement of legitimate cost reductions; and

- Extend the application of the value engineering technique to all areas where it can be productive.

To reach these objectives it is recommended that the Department of Defense take the following implementing actions:

1. Issue a strong policy[1] which would reinforce the Department of Defense's already stated endorsement of the

1. An example of the type of policy proposed appears as Exhibit 1.

value engineering program. The tone of this policy directive should be that of interest in expanding the use of the value engineering technique to all areas where it can be productive.

2. Provide clear evidence of the continuing support of value engineering by scheduling visits by top level DOD officials to a number of defense contractors. The purposes of these visits would be to convey at firsthand the officials' interest in value engineering and to question the defense contractors about their progress in implementing their own V.E. programs.

3. Revise the Armed Services Procurement Regulation to provide direct financial incentives to defense contractors for the successful performance of value engineering. The guiding principle of the incentive provisions should be financial rewards which are based on actual results achieved, risk taken and relative return on investment.

4. Provide strong systems of program control which will set targets, measure progress against those targets and obtain qualitative analyses of the value engineering programs in operation both in DOD activities and in contractor establishments.

5. Develop improved training programs and provide or sponsor the establishment of training facilities. These actions would be designed to:

a. Upgrade the professional competency of present value engineers; and

b. Increase the supply of qualified practitioners of value engineering.

6. Publish a Value Engineering Handbook which would serve as a guide to establishing successful value engineering

programs. The V.E. handbook would define the scope and substance of the V.E. program with particular emphasis on description of the methodology, standards for selecting items for V.E. study, methods of organizing the V.E. function and procedures for controlling the program once established.

7. Provide on-site implementation assistance to DOD producing and procuring activities and upon request to defense contractors. This on-site assistance should be provided by teams of highly qualified personnel who are familiar with the requirements of the V.E. program and with the technologies to which the program will be applied.

8. Issue a value engineering specification which would establish minimum standards for the performance of value engineering under program requirement clauses in defense contracts. The V.E. specification would provide guidelines to defense contractors who are required to perform a value engineering function at the expense of the government.

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I. INTRODUCTION

A. BACKGROUND

Shortly after taking office, President Kennedy directed the Secretary of Defense to determine the force structure necessary to our military requirements and to procure and operate this force at the lowest possible cost. As a result, the Secretary of Defense established a number of basic operating policies, one of which was to buy only what was needed by eliminating all "goldplating" in defense procurement.

As one method of implementing the above operating policy, it was decided to analyze specifications, standards and designs in terms of their cost effectiveness. To that end, studies of those areas were initiated with the goal of recommending programs to facilitate the use of various cost reduction techniques, such as value engineering - all with the purpose of bringing cost and effectiveness into better balance. This study program, designated Project 2A, was made the responsibility of LMI. Subproject 2 of Project 2A was specifically directed to the technique known as value engineering.

Formal value engineering was developed by the General Electric Company shortly after World War II. The results obtained by G.E. stimulated outside interest in this approach to cost reduction, and in 1954 the Navy's Bureau of Ships became the first defense agency to apply V.E. to its products. The initial Bureau of Ships application was directed to naval shipyards, and soon after included private shipyards as well. The Navy experience, as well as that of the Army and the Air

Force, led to Department of Defense interest in value engineering and to its inclusion in Project 2A.

The initial approach taken by Logistics Management Institute in its V.E. study was to conduct a short intensive survey of value engineering in the Department of Defense and industry to determine its potential as a cost reduction tool for use throughout the defense-industry complex. This survey was completed in June, 1962. The V.E. project plan resulting from this survey was based on the conclusion that V.E. had significant potential as an effective cost reduction tool. The project plan also recognized that many problems existed which required solution before value engineering's inherent potential could be attained and therefore contained specific task orders directed at solving these problems.

B. SCOPE

In order to attack the problem areas in an organized manner and to provide for a logical division of effort, eight task orders were established as follows:

1 - ANALYSIS OF CURRENT VALUE ENGINEERING PROGRAMS WITHIN DOD;

2 - ANALYSIS OF CURRENT VALUE ENGINEERING PROGRAMS WITHIN INDUSTRY;

3 - MONITORSHIP AND ASSESSMENT OF THE MINUTEMAN VALUE ENGINEERING PROGRAM;

4 - STUDY OF VALUE ENGINEERING TECHNOLOGY;

5 - DEVELOPMENT OF MEASUREMENT SYSTEMS;

6 - DEVELOPMENT OF IMPROVED V.E. CONTRACTUAL INCENTIVES;

7 - DEVELOPMENT OF MOTIVATIONAL TECHNIQUES FOR VALUE ENGINEERING; and

8 - DEVELOPMENT OF IMPROVED PROCEDURES FOR THE IMPLEMENTATION OF V.E. CHANGES.

Because of the size of the study effort, it was necessary for the Logistics Management Institute to subcontract portions of the work. Participating with LMI as subcontractors were Space Technology Laboratories, Marcom, Inc. and the Society of American Value Engineers. In addition, significant inputs were provided by selected personnel in the Office of the Secretary of Defense, Department of the Army, Department of the Navy, Department of the Air Force and the Defense Supply Agency.

In the course of the study the project teams visited or contacted approximately fifty defense contractors and a similar number of DOD personnel at installations and activities all over the country. A listing of the organizations which were contacted appears as Exhibit 2 of this report.

II. FINDINGS AND CONCLUSIONS

A. GENERAL

A general analysis of the present state-of-the-art of value engineering in the DOD-industry complex reveals that despite its many shortcomings, V.E. is currently producing annual savings[1] of approximately $60 million. This level of savings generation is clearly far below the total potential obtainable through the full-scale use of the technique. LMI estimates that the total potential of value engineering is at least $300 million in annual savings.

The $300 million savings figure is arrived at simply by assuming that: (a) the number of fully trained value engineers employed in the DOD-industry complex is increased from the 500 presently employed to 2,500; and (b) the average savings productivity of each engineer in the V.E. work force will remain constant. These assumptions appear to be conservative because:

- Value engineering is now being unsystematically applied to less than 20% of the components being produced by the defense industry.[2] Although it would not be economically or technically justifiable to attempt to apply V.E. analysis to all hardware components, a systematic selection of items should make it possible to

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1. As used in this report, "savings" refers to net overall cost reductions which include cost reduction in production, logistics support, maintenance and operating costs.

2. 20% measured in terms of dollar value.

apply V.E. to the items accounting for most of the dollar costs.

- Many V.E. applications are lacking in intensity and do not achieve maximum reductions in component costs. Hence, the full-scale use of the technique has a potential for increasing the cost reductions achieved per application.

- The engineering change procedure operates in a manner which makes action on V.E. changes very time consuming, thus significantly reducing the savings which approved changes produce. Acceleration of actions on V.E. changes is feasible and, if achieved, should increase the cost reductions produced by the V.E. changes.

- The constant changes in the products making up the output of defense industry should make it possible to secure savings from V.E. on a sustained basis. The law of diminishing returns should not be applicable to the extent that it would be in an industry producing products which did not change significantly from one year to another.

In summary, the effectiveness of the average value engineering program in current use is well below maximum and the current DOD-wide level of effort in value engineering is only enough to apply V.E. to 20% or less of the present annual volume of DOD hardware procurement.

Both of the preceding reasons for value engineering's present status are, in turn, due to a number of factors, many of which are inter-related. These include such items as

management attitude (in DOD and industry), the value engineering methodologies in use, the procedures used to decide where to apply value engineering, present programs for training value engineers, ways used to organize value engineering efforts and the levels of effort to be employed, procedures in use for processing value engineering proposals and the methods used to provide incentives and motivation for doing value engineering. The findings and conclusions drawn from an intensive study of all of these factors are presented below, followed by recommendations (Section III) designed to correct and improve value engineering programs where necessary to make them more effective and to accelerate the wider use of value engineering as a major cost reduction tool in the defense-industry complex.

B. MANAGEMENT ACCEPTANCE AND SUPPORT OF V.E.

One of the serious drawbacks to value engineering's attainment of its full potential has been a lack of understanding and acceptance of value engineering on the part of management officials both within the Department of Defense and defense industry. This is in no way critical of these management officials in that there have been good reasons why value engineering has not gained acceptance. These reasons essentially relate to the unimpressive results obtained from value engineering to date. The value engineering fraternity has claimed that a main cause of these limited results is the fact that V.E. has not received proper management support. The situation is, therefore, somewhat akin to the riddle of the "chicken and the egg." Management has not been willing to fully support a technique which has not proven itself to their satisfaction. Value engineers on the other hand, claim that a lack of management support has hampered their efforts and slowed the development of the value engineering technique. This is perhaps an

oversimplification of the problem existing between the practitioners and management, but there is no doubt that it is a real problem.

There are other important reasons why value engineering has not achieved widespread acceptance by DOD and industry management. Overstatement and erroneous calculation of savings estimates have certainly contributed to management's skepticism. Industry management has been slow to respond to V.E. because there were not sufficient incentives to spur action, particularly financial incentives. Even in those cases where value engineering incentive clauses were written into defense contracts, industry management became disenchanted with the whole operation when they encountered extensive delays in the processing of their cost reduction change proposals. Furthermore, until recently there has not been a clear statement from the Department of Defense indicating real interest in having value engineering performed on defense contracts. The present DOD management has taken specific steps to eliminate this deficiency. Each of these specific problem areas is discussed in greater detail in a succeeding section of this report.

One should not imply from the above statements that value engineering has gained no appreciable level of acceptance whatsoever in the DOD-industry complex. There are notable exceptions to the general statement. Several major defense contractors have installed strong value engineering programs and they back them with top level support. (See Exhibits 3 through 5.) Similarly some organizations within the Department of Defense have likewise been able to establish viable value engineering programs which have achieved rather substantial results. (See Exhibits 6 through 9.)

The desired objective of obtaining effective management support for value engineering can only be achieved by concerted effort in the following areas:

- A clear statement from DOD publicizing its serious interest in the use of the technique wherever applicable and tangible demonstration of this interest through:

  Improvements in the change procedure which will expedite processing and evaluation of the V.E. change proposals; and

  Provision of more liberal financial incentives to industry for the successful performance of value engineering.

- A marked improvement in the discipline of value engineering including a more precise methodology, more systematic selection criteria for determining when and where to apply value engineering and higher quality training programs.

C. THE DEFINITION AND METHODOLOGY OF VALUE ENGINEERING

1. Definition of V.E.

At the present time, there are almost as many definitions of V.E. as there are value engineers. Most, however, are fairly similar and differ only in minor wording. In recent years much unnecessary effort has been devoted to the attempt to develop a single definition which would be acceptable to everyone. Attempts to get widespread agreement on the precise wording of a definition have not proven productive. What is needed is a brief, concise definition which most practitioners can agree with and, more importantly, one that will enable value engineers to get on with the job to be

done. It is the conclusion of LMI that the following definition meets this requirement:

> "Value Engineering is an organized effort directed at analyzing the function of defense hardware with the purpose of achieving the required function at the lowest overall cost."

A common understanding of the terms employed in this definition is important in clearly defining the value engineering program. A further explanation of the key phrases of this definition is therefore in order.

By "organized effort" is meant a methodology or a set of procedures which draws together and utilizes any and all techniques necessary to achieve the desired goal. It is not meant to imply that V.E. is a science or technology in the sense that physics or chemistry are considered as such, but rather that it is a logical, organized method of applying other technologies to the solution of the value problem. The drawing together and utilization of the techniques necessary to achieve the desired goal also require formal, explicit, organized effort to bring to bear on each specific value engineering task the required engineering, scientific and managerial abilities.

Some practitioners of value engineering limit its application to hardware, others extend it to cover any and all cost reduction activities. For example, cases involving rearrangement of a cafeteria, reorganization of a telephone book, control of overtime and paper work procedural analysis have been cited as examples of good V.E. practice. In a strict sense, it can be shown that such actions contain the major elements of V.E. because all were attempts to find lower costs of achieving a required function. It is the conclusion of LMI,

however, that V.E. should be concentrated in those application areas where it can provide the greatest overall contribution to the Defense effort. Value engineering cannot effectively embrace within its statement of capability, and should not attempt to embrace, all cost reduction functions. There are other techniques to achieve cost reductions in non-hardware areas such as work measurement, procedures analysis, work simplification, etc., which are more effective than V.E. and which do not require as great a use of scarce technical and engineering skills. The total job to be done by V.E. in defense hardware alone is so vast that any application of V.E. elsewhere seriously dilutes the effectiveness of the V.E. program.

As used in this definition, "function" is synononomous with performance. "Required" means that neither more nor less than what is actually needed and wanted is provided.

It is believed that the proposed definition is accurately descriptive and properly focuses value engineering efforts in those areas where it can be most productive.

2. Methodology

As is true in the case of the definition of value engineering, there are a wide variety of methodologies now being employed in the application of value engineering. A review of a representative sampling of these different approaches reveals that the similarities between them are much more prevalent than their dissimilarities and that many of the dissimilarities are actually only problems of semantics.

The adverse effects of the utilization of a number of various methodologies have not been of a really serious nature, at least not when compared with other deficiencies in value engineering as applied today. One adverse effect which

is worthy of note, however, is that there has been a lack of consistency in the results achieved in value engineering projects. Some of the less structured methodologies have left out or minimized the importance of several key steps in the project study plan. This has resulted, in some instances, in a less than attainable cost reduction. It is not possible to achieve maximum results with an ill-defined project study plan.

In the opinion of LMI, no single approach among those studied represented an optimum description of the methodology. By taking the best from among several approaches, however, it is possible to piece together an effective methodology that should be acceptable to all concerned and will provide an organized, systematic approach to the conduct of a value engineering analysis of any given piece of hardware or components thereof. A description of the proposed methodology is presented below.

There are seven basic elements of the proposed value engineering methodology. These elements are not always distinct and separate - in practice, they often merge or overlap.

To be an organized discipline, a value engineering effort should be comprised of <u>all</u> <u>seven</u> elements. In some procurement agencies or contracting firms, these elements of the V.E. job are "scattered" as "collateral" responsibilities assigned to design engineers, production engineers, purchasing specialists or engineering cost analysts, under the assumption that collectively, value engineering efforts are being accomplished. Under such circumstances, however, it is practically impossible to plan and control V.E. efforts; they are too diffused and too often given only lip-service. Therefore,

value engineering is (or can be) an organized, effective discipline only when personnel devote their full-time efforts to all seven elements of the V.E. job.

The seven elements are:

- Element One - Product Selection

The amount of resources that can be allocated to the V.E. function is limited. Therefore, it is of the utmost importance that these scarce resources be applied where there is high potential for cost reduction. The predetermination of those items which will offer high savings return from value engineering is admittedly a difficult task. Because this element of the V.E. methodology, Product Selection, is so vital to the overall success of the V.E. program and is sufficiently complex that it requires an extended discussion, this subject is covered in detail in the succeeding section, Criteria for Applying Value Engineering. This section presents the guidelines which are available for pre-selecting the products which apparently have a high savings potential.

- Element Two - Determination of Function

By function is meant the purpose or objective of the hardware (subsystems or components) under consideration. In simple terms, functional requirements are those explicit performance characteristics that must be possessed by the hardware if it is "to work." They define the limits of what the hardware must be able to do in relation to the larger system of which it is a part. The method for doing this "work" is only implied by these performance requirements; it is the designer's job to make this method tangible and explicit. Thus, functional requirements are the ends that imply the means (i.e., the hardware design) to provide for these ends.

In attempting to define function, it is helpful to the value engineer to describe it in the form of two words - one verb and one noun. For example, in the case of a thermometer, the basic function is "register temperature." There are two reasons for so restricting the definition of function:

> The use of two words avoids the possibility of combining functions and attempting to define more than one simple function at a time; and
>
> The use of two simple words will achieve the lowest level of abstraction possible with words - the identification of the function should be as specific as possible.

The value engineer should be careful to identify all required functions, whether they are primary or secondary. For example, a light source also may be required to withstand severe environmental conditions or a handle also may be required to provide for locking. Accurate description of each required function in quantitative terms is a prerequisite for successful value engineering of the product.

- Element Three - Information Gathering

Once having defined the function, the value engineer next embarks upon an intensive information gathering effort in two phases: (1) specific information about the product itself, such as cost of the present design, quality and reliability requirements, maintainability characteristics, volume to be produced, development history, etc.; and (2) general information concerning the technology of the product, including present state-of-the-art, vendor sources of supply for components of the item, processes to be employed in its manufacture

and establishment of contact with individuals in the organization who have technical knowledge of this type of product.

The value engineer should compile all information about the product under study within the time constraints of the project and to the best of his ability. Particular emphasis must be placed upon getting accurate cost data on the item as presently designed. This will require contact with cost estimators, cost accountants, purchasing personnel and any others within the organization who may have cost data. Obviously, an accurate comparison of alternative costs with present costs requires precise cost data. No element of cost should be overlooked. Direct labor, material and factory burden - all must be included, with a careful discrimination between the fixed, semi-variable and variable items of factory burden.

More than just specific knowledge about the product is required if a thorough study is to be done. It is essential to possess, or have access to, all available information concerning the particular technology involved. Awareness of the latest developments in the field is required. A particularly good source of information is provided by specialty vendors, who supply components for the type of product under study. The value engineer should familiarize himself, to the maximum practical extent, with the various manufacturing processes that may be employed in the manufacture of the product. He should avail himself of any knowledge concerning the particular product area which may exist anywhere in the organization. The more information brought to bear on the problem, the more likely is the possibility of substantially reducing the cost of the product under study.

- <u>Element Four - Development of Alternatives</u>

At this point, an intimate knowledge of the item under analysis has been developed and a basis for the most difficult and intangible portion of the process established. This is the creative portion of the value engineering activity and, depending upon the individual or individuals involved, may take many forms. The purpose is to generate ideas about the item's function and design and conceive of more economical and equally effective means of performing the same function. Analytical methods, iterative methods such as check lists (see Exhibits 10 and 11) and unstructured procedures such as brainstorming may also play a part in this process. Whatever methods are used, the basic purpose is to create a series of alternative designs, all of which will guarantee required function, and one of which will, hopefully, reduce cost.

- <u>Element Five - Cost Analysis of Alternatives</u>

The various alternatives developed in the previous step of the V.E. process next are subjected to a test of their economic feasibility. That is, each alternative is costed with the goal of finding the least costly, the next least costly, and so on until all alternatives are ranked according to cost. This then permits <u>detailed</u> technical (and economic) study of the alternatives on a priority basis, with the highest potential savings alternative first, to determine whether the alternative will lead to significant cost reduction. It may also cause further efforts at developing alternatives or may lead to a cancellation of the V.E. study, since it may show that no alternative is significantly less costly than the present method of meeting required function.

The costing of alternatives should take place in two broad steps. First, a gross cost estimate is made. Second,

based on the gross estimate, more detailed and refined estimates are prepared.

The purpose of the gross estimate is to arrive at quick indications of the relative worth of the alternatives as well as to rank them. The gross estimate may be nothing more than an estimate based on comparing the elements, materials and processes of the alternative and the original (or present) method of providing function. Unless there are significant differences - fewer parts, easier to assemble, less expensive materials, the alternative probably is not significantly better than the original. Although it should not be discarded completely, it should be considered further only after gross costs of more promising alternatives have been estimated.

As previously described under Element Three, Information Gathering, the original (present) method of providing required function is costed as carefully and accurately as possible. Similar effort is required for each alternative method of providing required function which appears to have merit based on the gross evaluation of cost and technical feasibility.

The steps in the detailed cost analysis are: (1) estimating the number of units to which the change will apply; (2) estimating the variable cost of manufacturing the alternative; (3) estimating the fixed costs of manufacturing the alternative; (4) estimating all of the costs necessary to implement the change into production; and (5) estimating the logistics costs of supporting and maintaining the alternative.

In addition to fixed costs discussed in the previous steps, costs of conducting the V.E. study, costs incurred in the management review of the V.E. proposal, costs of negotiating

Contract Change Notices and administrative handling expenses must also be deducted. Originators of proposals must develop for most of these latter areas a schedule of surcharges to be applied against each V.E. change proposal. Again, consistency in application is necessary.

If after deduction of all fixed costs from the gross savings the net savings are substantial, the alternative method is economically feasible.

The cost data derived in analyzing an alternative can be used in other ways, such as calculating breakeven point, figuring return on the V.E. investment and for future reference in preparing cost estimates for similar hardware items. Of course, its first use will be in preparing the formal V.E. change proposal, since this is the basic evidence supporting adoption of the alternative.

- Element Six - Testing and Verification

All economically feasible alternatives developed in the V.E. study must be tested to ensure that they will provide required function. If they do not, they are rejected from further consideration unless modified to meet functional requirements.

In assessing technical feasibility, each required function is examined in turn. As previously described, primary and secondary functions are originally defined in terms of what the product or item must do, with what accuracy it must perform, how dependable the product must be and under what environmental conditions it must operate. In addition, required function may include elements related to operation and maintenance, such as safety, ease of repair and accessibility, etc. The value engineer attempts to determine whether the

alternative method meets each of these elements of required function.

- <u>Element Seven - Proposal Submission and Follow-up</u>

Once the V.E. team or value engineer has assured himself that an alternative is economically and technically feasible, and is the best alternative of all developed, a formal proposal is prepared recommending adoption and implementation of the alternative.

The preparer of the proposal should be guided by considering the procedures used by others in evaluating it. Specifically, he should view his proposal as others will view it. If the report does not communicate effectively, the whole study is in jeopardy.

In addition, it is necessary to consider the man, or the group of men, that will read the report. They are busy; they want the facts quickly and concisely. Yet, the report must tell them all they want to know about something with which they are not familiar. Before and after must be clearly explained. The before must be briefly reviewed. The after must be justified. Precise costs of both must be cited. In short, the entire V.E. study must be summarized concisely and accurately.

A standard form should be used wherever possible, supplemented with graphic material as required. Exhibits 12 through 14 are illustrative of such forms. A standard form is recognized, and its purpose is immediately understood; it can be circulated, reproduced and reviewed with more efficiency. In large organizations where many studies are undertaken, a standard form can also be used for filing and reference.

By following the preceding suggestions, proposals will be prepared which facilitate prompt, accurate evaluation based primarily on the merits of the proposal - a desirable goal for the V.E. effort.

Once the proposal is submitted, it must be followed up periodically in order to monitor its progress. An example of such a form is presented as Exhibit 15. The responsible value engineer should regularly make a check of who has the proposal and what its current status is. Occasionally, there are delays in initiating evaluation action on the proposal. Every effort must be made to minimize these delays if maximum savings are to be achieved.

D. CRITERIA FOR APPLYING VALUE ENGINEERING

One of the more serious deficiencies in the value engineering technique as applied today is that there is a dearth of logical and systematic criteria for determining when and where to apply value engineering. The LMI study revealed that most value engineering projects were selected on a rather haphazard basis with no real concern for maximizing the return on the investment of value engineering resources. This has resulted in a level of achievement far below the potential offered by the use of the technique. Even with the limited resources available today, which admittedly fall far short of the total resources required to mount a maximum effort, it would have been possible to produce substantially more in the way of savings if the available resources had been applied to those areas where the return on investment was greatest.

It is not always an easy task to predetermine the highest savings potential projects. This is an area, however, where even a relatively minor advance in the state-of-the-art can produce substantial improvements.

In order to maximize the return on investment, it is necessary to provide answers to two main questions:

> At what point in the product cycle should value engineering be applied; and
>
> On what items (subsystems, components, etc.) should V.E. resources be concentrated?

Each of these questions is explored in further detail below.

1. When to Apply Value Engineering

The problem of determining when to apply value engineering in the product development cycle is one that has been given a great deal of attention by both DOD and industry value engineering groups. Widely divergent views exist on the question of whether value engineering can be applied before or during the design of an item or whether it can only be applied after design is completed. To illustrate the extreme positions, some companies apply value engineering, or at least what is labeled value engineering, in the very earliest conceptual stages of a project. On the other hand, some companies apply value engineering only to products which are already in production.

Proponents of the early application concept argue that the earlier the V.E. changes are introduced the greater the savings that can be achieved. There is certainly no argument with this general statement. Others would argue, however, that even though the savings potential is greater, it is impractical to apply V.E. in the early stages. The opponents of early application state that much of the early V.E. work has to be redone as the design develops because the initial designs simply do not work or problems of compatibility arise at the point of

systems integration. They further state that it is extremely difficult to apply V.E. in the early stages because of a lack of definitive cost and technical data. There is another factor which bears on this problem, that most V.E. practitioners are unwilling to admit; that is that the "technology" of V.E. is still embryonic and fluid and that, therefore, it is much more difficult to apply it to products that have not yet achieved a finalized design state.

Part of the problem or controversy between the "early appliers" and those who support post-design application is actually a problem of semantics. Applying cost considerations before and during the initial design effort is actually good, cost conscious, efficient, design engineering practice. It is somewhat inaccurate to label this as value engineering. Certainly efficient cost conscious design engineering is a desirable and necessary goal. The facts are, however, that it is a long way from being achieved and is understandably so because of the intense pressures in the defense effort for performance, reliability and early delivery. Value engineering is generally considered to be something above and beyond the present status of original design practice. It is an adjunct to it - a method of giving cost and value consideration to products after the prime goal of designing a workable product as quickly as possible has been met. This would seem to suggest that V.E. is not applicable during the design stage of an item. Such is not the case, however, and again the problem is one of semantics involving the meaning of the word "design." In the broad sense, design means that period of effort between the establishment of initial concepts and the start of production. In the narrow, more precise and traditional sense, design means the initial creative process which translates

concepts into sketches, drawings or blueprints and which is only the first step of the total process leading to production of an item. V.E. is not applicable to the initial creative process; it is applicable to all that follows. It is in this sense that V.E. can be considered applicable to the design of a product.

The actual point of application selected is based on two factors. The first is a matter of obtaining the most savings from V.E. This would argue for applying V.E. as early as possible in the life cycle of a product for two reasons: (1) the more units of product to which cost reduction changes apply, the greater the total savings generated by the change; and (2) the earlier the change, especially if it can be made before production begins, the lower the implementation costs, both from the standpoint of modifications to production lines, tooling, procedures, etc., and from the standpoint of changes to logistic and support elements such as spares, manuals, maintenance facilities, etc.

As stated earlier, however, too early an application is not desirable because, if V.E. is applied immediately after the first design attempt, it may well prove to be wasted effort if the first designs are subsequently modified or changed. It should be noted that in many cases the likelihood of change is quite large, especially in weapon system development because of the complexity and technical novelty of the designs, because of system integration problems and, most of all, because of the dynamic technologies involved.

From the standpoint of achieving maximum efficiency, then, it would seem that V.E. should be applied sometime before production begins, but after initial designs are completed. The

most important breakpoint, in any case, is the start of actual production runs.

The second factor affecting the timing of V.E. action is related to the ease or difficulty of actually accomplishing V.E. Although V.E. can be applied to completed design, it has been found that the process is easier to do if the product actually exists in physical form. In addition, it has been found that the evaluation process is easier if the product is already in existence, because costs are easier to gather and estimate. These considerations would argue for the introduction of V.E. downstream in a product's life cycle.

Resolution of the seeming conflict between the two factors just developed can be made by selecting a point in the product's development which satisfies both as much as possible without sacrificing savings potential. On this basis, the application of V.E. at a point between initial design and production is suggested, with the actual selection of the specific point a function of the product, the organization's already established procedures, existing control points and the manufacturing or development process itself.

Most of the preceding discussion about when to apply V.E. applies primarily to new development programs. It is not suggested that the use of V.E. be limited only to such programs, however. Many products already in use never were value engineered and possibly can benefit from value engineering when they are reprocured. In addition, products which were value engineered initially may benefit from subsequent value engineering at reprocurement, if advances in technology have led to developments which could significantly lower costs while retaining essential function. The important point to recognize

is that value engineering applied to these products will not be as efficient and fruitful as it would have been if applied to them in their initial development stage. The reason is that many otherwise worthwhile changes will not be approved because the costs of implementation and the costs of changing logistics support are greater than the gross savings entailed in the V.E. proposal. Even those that are approved will result in less total savings because of these same costs and because they apply to a smaller number of units than if applied earlier. Therefore, V.E. should always be applied as early as possible after initial design.

2. Criteria for Selecting Items for Study

For the same amount of V.E. time and effort, the benefits that can be achieved from analyzing one item seldom are the same as the improvement that can be achieved from analyzing another item. This is significant to the manager of V.E. and to the value engineer. A preliminary analysis of all subsystems of an overall weapon system enables the manager to select subsystems according to cost reduction opportunities. A preliminary analysis of all parts enables the value engineer to select and rank the parts according to their potential value improvement.

As stated earlier, industry and government practice to date has generally been to select items for V.E. analysis on an unstructured or unsystematic basis. For example, many companies concentrate their V.E. efforts on studies generated by training seminars which, in turn, usually select their projects on the basis of their suitability for training purposes. Other organizations generate V.E. projects from suggestion programs, a practice which leads to a somewhat random application of V.E. efforts. Selecting items for V.E. study

on such bases as these clearly will not lead to the achievement of a maximum return on the cost of the V.E. program.

This is not to say that all companies with government contracts are characterized by unstructured selection of items for V.E. study. On the contrary, the LMI analysis revealed that several companies were using rather sophisticated value standards (see discussion of value standards below) to pre-select those items which would offer the greatest savings potential from the application of V.E. Other companies were selecting items because the profit margins on the items were either non-existent or extremely thin. This latter approach is, in effect, the application of a rough value standard, i.e., that of the market place, to the selection of items for V.E. study.

Based on an analysis of the state-of-the-art as it exists today, LMI concluded that there are three effective criteria for the selection of high savings potential items. Each of these criterion is discussed below.

a. <u>Value Standards</u>

Value standards are of two types: theoretical standards, based on a mathematical expression of the product's function, and historical standards, which are based purely on historical cost data on the same or related products.

Several points concerning the theoretical value standard should be noted.

First, the standard is derived from physical laws or formulas and is based on the inherent physical and chemical properties of materials or systems.

Second, the theoretical standard eventually must include costs - and these are always historical. Usually,

long-term average costs are used but, even so, such costs can change over a period of time.

Third, the standards are always based on the present state of scientific knowledge and, thus, are subject to change over a period of time.

Fourth, it appears that these value standards are more precise and meaningful than those based purely on the traditional or historical cost of a given product.

Finally, it must be recognized that theoretical value standards are quite difficult to compute and, for this reason, are available only for very limited product areas. Furthermore, many of the existing standards of this type are considered to be trade secrets and, therefore, not generally available.

Historical value standards, on the other hand, are comparatively much easier to develop and are more generally available than theoretical value standards. Essentially, they are based on a presumption that products which have been in existence for some time, especially if they are highly competitive products, are produced efficiently and sold at a reasonable price. In other words, it assumes that their cost is a good indicator of their real value.

Value standards of either type are an effective tool for selecting items to be subjected to value engineering. In the preliminary review of a number of products or a number of components of one product for purposes of determining the area of greatest potential return from value engineering, the actual or estimated cost of the various functions is compared with the standard for those functions. If the item's cost

greatly exceeds the value indicated by the standard, it should be considered an appropriate candidate for value engineering.

Even on new weapon systems, many of the subsystems or components have been used in previous systems. Therefore, historical cost data are probably available for those items and should be used as a rough "value standard" in determining whether the items are likely prospects for value engineering.

b. Relative Cost Ranking

In the absence of value standards, the estimated cost of the parts or subsystems can be ranked from highest to lowest in terms of dollars per unit of the product and total dollars per product. Generally, potential value improvement is greatest on those components of highest unit or total costs.

Sources of information and techniques for estimating costs were discussed earlier in this report. These estimates need be accurate only in a relative sense for the purpose of ranking each component according to its approximate percentage of an estimated total cost of the product or system (the total cost might be assigned an index of one thousand (1000); each part may then be assigned a relative cost index which is a percentage of one thousand (1000)).

The estimated costs to be considered should include the direct costs of producing the part (including special tools, facilities, etc.) and the cost of supporting the product (i.e., supplying and maintaining the product) throughout its expected useful life. Since some parts may be subjected to wear more than others, they will have to be produced in larger quantities per unit of product and replaced more often than others.

In short, product cost criteria should reflect the value engineer's judgment of expected costs of production and logistics support, expressed in rough, relative terms for each component of the product. Two "relative cost indices" can be assigned to each component, one for relative production cost and the other for relative support cost.

The basic cost factor used in determining relative priorities can be further refined by applying the following additional measurement criteria:

- Complexity of the product - generally, the more complex the product, the more opportunity there is for improved value.
- State of development of the state-of-the-art - those product designs that are pushing the state-of-the-art normally will offer substantial potential for value engineering.
- Degree of time compression in the development cycle - a product which has had an accelerated development program usually contains elements of overdesign.

All three of the above criteria are directly related to cost although not all high cost items have these characteristics. However, high cost items characterized by one or more of these attributes are likely prospects for the application of value engineering.

c. Correlation of Resources to Task

The term "value engineering resources" refers to the kinds of facilities and know-how possessed by a value engineer and his organization. For example, one value engineer

may possess knowledge and experience in "engineering the value" of electrical-mechanical systems; another value engineer may have concentrated most of his knowledge and experience on improving the value of electronic circuits. Assuming that a product to be value engineered contained two subsystems, one electrical-mechanical and the other electronic, the probability of maximizing improvement in the value of this product is greater if the knowledge and experience of the two value engineers are matched with the two subsystems.

Thus, this criterion for where to apply V.E. techniques has to do with a "qualitative analysis" of available resources and the V.E. job to be done. Resources and the job requirements must be matched in such a way as to generate the greatest savings per man hour spent on value engineering.

E. SELECTION AND TRAINING OF VALUE ENGINEERING PERSONNEL

During the course of the V.E. study, it was found that industry and DOD were aware of a need to select, develop and train additional value engineers. The existence of several DOD training courses plus a number of private companies devoted almost exclusively to providing DOD and industry with training courses and seminars for potential V.E. practitioners, indicates that the need for such services already is a real and pressing one. As the V.E. program moves into full operation, the need will increase rapidly. As pointed out in the beginning of this report, the estimated minimum number of value engineers required to staff the V.E. program is 2,500, but the present number available is approximately 500. Thus, 2,000 additional personnel are required.

Because the shortage of trained talent was a large potential roadblock to the DOD-wide V.E. program, major study effort

was directed to it by LMI. The study concentrated first on determining the effectiveness of present approaches to selecting and training value engineers and, second, on determining what actions to improve or increase the scope of the present approaches were required.

1. Effectiveness of Present Approaches to Selecting and Training Value Engineers

a. Selection Techniques

Virtually every known approach to selecting personnel for any given job has been used in the past to select value engineers. In some cases, individuals "campaigned" for the establishment of a value engineering program in their own company, then moved into a V.E. position once management accepted the need for V.E. In other cases, management established the V.E. program, selected a promising (and available) engineer and made him chief value engineer. In other cases, value engineers in one company were recruited to work for another. In the majority of cases, then, selection was essentially an unsystematic affair.

In some instances, however, it was found that the selection approach was based on a search for those characteristics and talents which the value engineering function appeared to require for successful accomplishment. Many, if not most, of the following personal attributes were considered: technical competence in the product field, a broad technical background, a curious and inquisitive mind, a distrust of the status quo, a healthy respect for cost and profits and the ability to communicate ideas and concepts efficiently and with clarity. In addition, being a proven performer, who is capable of earning and retaining respect by demonstrating his objectivity and

sound thinking, appeared to be an important selection criterion. Finally, and very important, was a demonstrated ability to manage the introduction of change into complex organizational environments.

LMI concluded from its study of the selection methods that the last approach outlined, although by far the most difficult, nevertheless was the most effective method for selecting value engineering candidates.

b. Training

Once a candidate for the V.E. program has been selected, it is then necessary to train him. A number of methods are in current use which range in essence from the "throw-them in-the-water-to-sink-or-swim" approach (no training at all), to formal programs combined with comprehensive on-the-job training. As would be expected, the effectiveness of these approaches varies widely. A description of them is given below, followed by an analysis of their effectiveness.

(1) Description of Current Training Methods

- University adult education courses such as those given at UCLA and Northeastern University.
- Relatively short orientation courses. These courses are intended to be motivational and introductory in nature. Their use is fairly widespread among companies doing value engineering.
- Workshop seminars of twenty to sixty or eighty hours duration, combining lectures with actual V.E. project work. Some

seminars are given under the sponsorship of universities and professional or technical associations. Others are prepared and conducted by outside individual consultants, V.E. training companies or activities in DOD. Still others are given by internal company V.E. and training personnel. Examples of course outlines for various workshop seminars are shown in Exhibits 16, 17 and 18. Most companies with V.E. programs use workshop seminars as part of their training efforts.

- On-the-job training programs, usually of six months duration or more. These programs involve classroom work and rotation through the organization's operating and staff departments. They are used by very few of the organizations contacted during the V.E. study.

- Follow-up and indirect training and motivation efforts. These include, for example, the use of newsletters and house organs, posters, the giving of awards and citations. the support or sponsorship of professional organizations or societies such as S.A.V.E., hardware displays showing actual case histories of products before and after value engineering and short conferences used to discuss new developments and outstanding cases of V.E. effort. Most organizations with V.E. programs use efforts such as these.

These approaches do not necessarily have common objectives. Some motivate interest and acceptance of V.E., others provide theory and background and still others provide practice and experience in doing value engineering. Some of the approaches outlined attempt to go into depth about the various disciplines brought together in V.E., such as cost analysis and design practices.

(2) Effectiveness of Current Training Methods

All current training programs appear to presuppose a basic level of experience and competence. They seem mainly to be applicable to trainees who have completed their formal education.

The adult education courses, workshops and on-the-job programs generally were found to be effective and useful. Such is not always the case with the orientation seminar approach. In many cases, the seminars are almost exclusively motivational in nature. The contents of such seminars place a preponderance of emphasis on ballyhoo and inspiration; little emphasis on technique and procedure, or on practice in actually applying V.E. As a starter and introduction to V.E., the orientation seminar approach can be useful. It appears, however, that their value could be greatly increased if the seminars were reorganized so as to provide major emphasis on the theory and technique of value engineering (including demonstrations or cases of actual applications of V.E. to current products, if possible) a major element and propaganda or motivation a minor one. Further, the orientation courses can be quite expensive if large numbers of personnel are to be trained and if outside training companies prepare and conduct them. Thus, it is suggested that this type of training generally be conducted by in-house personnel.

Finally, it should be clearly understood that this approach alone is not of itself sufficient to teach V.E. and that on-the-job training is a mandatory adjunct if effective long-term results are to be obtained from the seminar approach in the form of trained, practicing value engineers.

2. Action Required to Improve the Selection and Training of Value Engineers

a. Selection

The most effective approach to selecting value engineers is the one previously described which looks for those characteristics in candidates which appear to be essential to effective V.E. work. However, it must be admitted that it is virtually impossible to find any individual who meets all requirements in full measure. Therefore, decisions must be made as to which characteristics are absolutely essential in any V.E. candidate. They appear to be technical competence, cost consciousness and the ability to work with other people.

Further, it will be necessary to use the more comprehensive selection techniques currently available to determine whether potential value engineers have the required talents and abilities. Among the techniques found to be useful are personal interviews, aptitude tests, resumés and detailed application forms.

Careful attention to the selection of personnel for the V.E. program will be highly rewarding because it will ensure that only qualified personnel participate, prevent many of the adverse reactions which unqualified personnel can unwittingly create, increase the efficiency and output of V.E. training programs and, in general, tend to upgrade the entire V.E. program.

b. Training

As the study of training requirements progressed, it became apparent that two training needs existed. One is training for those in the V.E. program; the other is training for those who will provide training and/or implementation assistance to the V.E. program. Both aspects are discussed below.

(1) Training for Program Personnel

In discussing improvements in training for program personnel, a distinction must be made between the full-time value engineering specialist, i.e., the "professional" value engineer, and other operating personnel. With respect to the specialist, training programs generally assume that formal academic training in an engineering or related discipline has been completed. Closely supervised on-the-job training and rotational work are considered to be the best methods for developing the V.E. specialist. The training objective is a fully qualified value engineer capable of holding his own in a formal value engineering job environment.

The training approaches available to develop full-time professional value engineers for the most part appear to be quite effective. Unfortunately, they take a great deal of time - and no practical shortcuts are in sight. Also, and again unfortunately, the major deficiency in the training of professional value engineers is the relatively small use made of available training techniques. LMI concluded that the biggest need is for greater utilization of on-the-job training and rotational job assignments, both coupled with appropriate formal training programs.

On-the-job training, or rotational job assignments should be planned with the value engineering methodology

clearly in mind. Thus, assignments and training should expose the value engineering trainee to: (a) those departments and functions in the organization which play major parts in establishing product functions and methods for providing function (preliminary and detailed design departments); (b) the departments which establish production processes and methods; (c) the departments concerned with cost estimating and product costing; (d) the areas of the organization responsible for purchasing and vendor relations; and (e) sources of new ideas and data about advances in technology inside and outside the company.

The formal training programs should consist of both lectures or seminars and selected readings from appropriate texts and periodicals. The emphasis of these programs should be on the economic aspects of V.E. - costing and estimating, return on investment concepts, utilization of resources, profit and loss concepts, value standards, cost models, accounting principles (as applied to V.E. projects) and all other aspects of the value concept. In addition to economic training, the formal training programs should stress technological innovations and progress as they apply to V.E. Finally, these programs should examine in detail the basic principles of the V.E. methodology.

The needs of those operating personnel who are not V.E. specialists can best be met through indoctrination lectures and participation in workshop seminars. The objective of this training is for the individual to develop a basic understanding of the goals of V.E. and to learn some specific techniques he can use in the performance of his regularly assigned responsibilities.

The indoctrination lectures and workshop seminars in current use for the most part meet the purposes

for which they are intended. Certain conclusions, however, concerning how to achieve maximum effectiveness from the seminars have been developed. In general, they are as follows:

- Require regular, full-time attendance from all participants;
- Limit the seminar's duration to not more than eighty hours, nor less than forty hours, over a period of two to four weeks;
- Limit seminar size to about forty to sixty persons;
- Maximize background diversity among attendees;
- Organize workshop teams in groups of about four to eight;
- Select workshop hardware projects on a realistic, practical basis, primarily for their training potential but as much as possible in accordance with the hardware selection approach outlined in this report - and certainly attempt to select a current, "live" project with genuine savings potential;
- Select qualified seminar leaders, both from the standpoint of training ability and V.E. ability; and
- Prepare the entire curriculum in advance in detail.

Obviously, the preceding training techniques are not mutually exclusive, nor will every organization need to employ all types of value engineering training at one time.

Decisions as to what types are appropriate and who is to be trained should depend mainly upon the size of the organization, the scope of its V.E. activities and the personnel selection criteria previously described.

(2) <u>Training Implementation Teams and V.E. Training Personnel</u>

As noted before, a growing need exists for qualified implementation personnel and V.E. training specialists. To put it another way, there is a major need for V.E. instructors and implementers, especially during the early stages of the expanded V.E. program.

In considering this aspect of the V.E. training problem, LMI came to the conclusion that initially a DOD training center, devoted exclusively to training V.E. instructors and V.E. implementation teams, was necessary and should be established. Personnel for this task would be drawn from DOD, industry and/or S.A.V.E. on a temporary basis. These personnel would first develop appropriate training courses and then train selected personnel to be V.E. instructors or members of V.E. implementing teams. The temporary personnel would remain at the training center until a sufficient number of graduates were available to perpetuate the training center (if desired) or until sufficient graduates were available to supply the needs of the expanded DOD-wide V.E. program.

c. <u>Longer-Range Training Improvement Actions</u>

All of the conclusions for improving the training of V.E. personnel previously presented are primarily concerned with the immediate steps which need to be taken. For the longer range, and recognizing that V.E. thus far is a collection of disciplines which has not developed a basic, quantitative, rigorous technology of its own, it would seem worthwhile

to support and encourage efforts directed at refining and broadening the technology of value engineering. Such efforts should help to speed the development of V.E. as a scientific tool instead of an empirical action. It must be admitted that this may not be possible. The potential reward for its accomplishment, however, warrants further investment in time and resources.

In addition, some of the disciplines currently used in the performance of V.E. could benefit from further research and study. Among the more important of these are cost models, predictive cost techniques, quantified definitions of value and value standards.

F. ORGANIZATION AND LEVEL OF EFFORT

1. Organization

During the course of this study, LMI and subcontractor study teams examined V.E. organizational structures in a number of companies holding defense contracts and in government procurement and producing activities. Not all of the organizations studied used the term "value engineering" to describe the function. Other terms such as value analysis, value control and value management were used, although by far the predominant term was value engineering.

It became apparent early in this study that there was no standardized pattern of organizing the V.E. function. Several representative examples of V.E. organizational structures are included as Exhibits 19 through 23. The type of organization established in each organization depended upon the effect of several key variables such as the size of the organization, the product mix involved and the organizational structure in existence prior to the introduction of the V.E.

function. It was further found that two distinct sub-functions existed in all organizations: the coordinating or staff function and the operating function. Although V.E. organizations varied considerably from one activity to another, they fell into several generalized patterns. A discussion of these generalized concepts and approaches is presented below.

a. Two Types of V.E. Functions - Coordinating and Operating

The coordinating function in the organizations studied was generally concerned with over-all program control, development and supervision of V.E. training programs, direction of in-house publicity programs and review and follow-up on V.E. change proposals in process. The operating V.E. function was concerned with the actual performance of value engineering studies.

The means of organizing these two sub-functions varied considerably from organization to organization. Nevertheless, in all instances, they remained distinct and identifiable, even in very small organizations where the two functions were embodied in one man.

b. The Effect of Key Variables on Organizational Structures

The size of the activity determined the number of levels in the V.E. organizational structure. In small companies the V.E. function was organized only in one unit or even in one man who was responsible for both the coordinating and operating functions. In large companies there was often a corporate director of V.E., division managers of V.E. and plant managers of V.E., all performing only the coordinating function. In addition, a number of operating V.E. units were found in many of the major departments of each plant.

The type of product produced by the activity also affected the type of V.E. organizational structure employed. Companies specializing in research and development and which were heavily engineering oriented, placed the principal focus for V.E. in the engineering department. Manufacturing companies, primarily engaged in the production of standardized military items procured in large quantities on a recurring basis, tended to concentrate V.E. effort in the production engineering department. Companies that subcontracted a large portion of the total dollar value of their products placed primary emphasis on V.E. in the purchasing department.

Most companies, upon establishing the V.E. function, attempted to integrate it into the existing organizational structure in such a way as to cause the least disruption in other already established functions. Several of the companies studied grouped value engineering with reliability, quality control and sometimes maintainability under a department or section labeled "Product Assurance." Other organizations established value engineering as a subsidiary function of either production engineering or industrial engineering.

c. Generalized Patterns of Organizing V.E.

In general, no distinct pattern of organization was found for the coordinating function in either producing or procuring activities. However, it was noted that in the more successful programs the coordinating function generally reported to an executive so placed in the organization as to be able to cut across departmental lines.

The operating functions in producing activities, however, tended to group themselves into three main categories as follows:

(1) Inter-functional Project Teams

Ad hoc teams of specialists, including full-time value engineers, are assigned to perform value engineering on specific components, subsystems or end items. Normally, the team is made up of representatives from various departments, e.g., design, production engineering, purchasing, industrial engineering and manufacturing. The complexity of the hardware and its cost will determine the intensity of analysis undertaken by the project team. The team may work on a full or part-time basis and may be established for a short term (two weeks) or for a long period of time (six months). The team approach can be used in any stage of the project cycle but, in practice, it more frequently is used downstream rather than in the design stage. This method of organizing the operating function has the advantage of bringing together a number of diverse, yet complementary talents which provide a multi-disciplined approach to the problem. The disadvantage of this approach is that it does not provide for the development of a continuing capability in depth, since project teams are normally disbanded after the completion of their task.

(2) Project Value Engineers

In this approach, a value engineer is assigned to a specific project to do V.E. from design through production. Here the value engineer normally has a high technical capability in the product area to which he is assigned. He is responsible for ensuring that optimum value is built into the product at every stage in its development. This method of organizing the V.E. effort has the advantage of providing a continuity of value engineering analysis through all design and production decision points. Its disadvantage is that the number of projects which can be value engineered is limited by the number of professional value engineers on the staff.

(3) Procedural Review Points

Under this method, a value engineer participates in all committee decisions at the established review points such as design reviews, make-or-buy reviews, systems integration and drawing release points. The value engineer, in this case, is responsible for ensuring that value considerations are given proper weight at each of these decision points. The role of the professional value engineer at the review points is principally one of determining whether value has been properly considered in the product's development and production. This approach permits the value engineering staff to subject more projects to V.E. analysis. It usually is linked with widespread training programs which attempt to train all personnel concerned with product value to perform V.E. as part of their everyday job. The disadvantage of this system is that it does not encourage any intensive, in-depth, value engineering studies.

There are many variations on the above three methods of organizing at the operating level. The three general patterns mentioned above are not mutually exclusive. Many organizations use combinations of the above - some even use all three at the same activity. The determination of the correct one to be applied at any given activity is a function of the variables referred to earlier (size, product mix, existing organization structure).

The type of V.E. training program used by the activity can have an effect on the type of organization selected. For example, an activity that has put a large number of people through a seminar training program could decide to select the third alternative mentioned above and use a few

value engineers only as monitors to ensure that value has been built into the product.

The types of organizational structures to be found at the operating level of procuring activities differ somewhat from those found in producing activities because their basic responsibilities are different. Operating groups in V.E. producing activities are primarily concerned with two responsibilities: (1) the processing and evaluation of value engineering change proposals; and (2) pre-procurement V.E. analysis of specifications. Many of the procuring activity V.E. groups studied performed only the first of these functions; others performed the second function only sporadically. In only a few instances was there evidence of a well-organized and adequately staffed group that was assigned to the pre-procurement analysis of specifications. Those groups that were heavily oriented toward the processing and evaluation of V.E. change proposals were most frequently located organizationally in the technical support staffs of the procurement division of the activity. In those cases where specification analysis was emphasized, the group was often organized as part of the engineering division of the activity.

(d) Conclusions on Organizational Patterns

There is no single pattern which represents the optimum organizational structure for performing the value engineering function. A distinction must be made between producing activities and procuring activities since their approach to V.E. is different because their purposes are different. A further distinction must be made between the coordinating function and the operating function. Even within these broad groupings, organizational patterns will, and should, vary

from activity to activity, depending upon several key variables, such as the size of the operation, the product mix involved and pre-existing organizational structure of the activity. Even the type of V.E. training program employed by the activity can have a significant affect on the type of organizational structure established. The important organizational factors which can be isolated and identified and that clearly contribute to the long-range success of the program are that the V.E. organization be identified, have clearly assigned responsibilities and report to a high enough level in the organization so that it has the ability to cut across departmental lines. If these three criteria are satisfied, the exact type of structure can be set up in whatever way best fits the overall organization into which it is being placed.

2. Level of Effort

Of the top one hundred defense prime contractors (contract dollar basis), forty-seven have value engineering programs. Of the forty-seven companies which have programs, twenty-three are among the top twenty-five prime contractors. (See Exhibit 24.)

Approximately 80% of the current industrial value engineering programs have been initiated since 1957, and about 60% have been started since 1959. The relative newness of industrial value engineering programs is a determining factor in the present low level of effort being applied to V.E. It is estimated that there are presently only about five hundred full-time value engineers employed throughout the defense-industry complex. The table below presents a breakdown of the number of full-time value engineers employed in the current major industrial V.E. programs.

FULL-TIME VALUE ENGINEERS PARTICIPATING IN VALUE ENGINEERING PROGRAMS AMONG THE TOP 100 DEFENSE PRIME CONTRACTORS

Number of Full-Time Value Engineers	Number of Defense Contractors
More than 50	1
41-50	1
31-40	1
21-30	3
11-20	3
2-10	29
1	9

It is difficult to directly relate the success of an industry value engineering program to the size of the staff which it employs. In the opinion of the LMI study team, however, the more successful value engineering programs employed more than twenty value engineers.

Under ideal conditions, it should be possible to determine the level of effort on the basis of the return on investment achieved by the value engineering program. In actual practice, at the present time this is often not possible because many of the costs of the value engineering program are buried in overhead and are not clearly identifiable, and also because savings computations have not been found to be reliable.

In the opinion of LMI, the long-range determination of the proper level of effort to be applied to value engineering should be determined purely on a return on investment basis. A reasonable rate of return to be expected is generally held to be 10:1, i.e., $10 of savings are generated for every $1 spent on the value engineering program. This is not, however, a hard and fast rule. It will vary depending upon the type of products being subjected to value engineering. For example,

on a development contract requiring the production of only a very few prototype models, a return of 3:1 or even 2:1 may be extremely desirable in view of the future potential savings that would occur if the item were later to be placed in volume production.

Although as mentioned earlier, it is difficult to establish precise rules for determining levels of effort, there is a general guideline which can be stated. An investment of from 1/10 of 1% to 1/2 of 1% of the total annual dollar volume is likely to be a reasonable level of investment for value engineering, particularly in those areas where value engineering has not been applied previously and where no history of return on investment ratios has been established.

The overriding consideration is the attainment of a reasonable return from the funds invested. Underinvestment in the V.E. function does not permit maximum utilization of the technique. Overinvestment causes a lower savings-to-cost ratio and damages the program by subjecting it to charges of "empire building."

G. PROCESSING V.E. CHANGE PROPOSALS

It was found that since V.E. proposals involve technical and economic feasibility and thus generally require a contract change or modification before they can be implemented, the most common method for processing them is through the engineering change procedure. The engineering change procedure is intended to ensure an orderly and controlled translation of the suggested improvement into an actual modification or change to a product, item or component. It also is supposed to serve as a means for checking whether the V.E. change will lead to beneficial results, i.e., the achievement of lower

costs with no sacrifice in required performance or function. In addition, the change procedure supposedly ensures that maximum benefits accrue as far as possible to all who are a party to the change and also that the change is made as promptly as possible to maximize the savings generated by it. Finally, use of the change procedure appears necessary to ensure that contractual obligations are met. This is particularly important in regard to savings calculations and to incentive sharing.

In view of the preceding, it is not surprising that many consider the change procedure handling of V.E. proposals to be a most important factor in the V.E. program - both because of the positive and negative effect which it has on motivating effective value engineering programs.

The following paragraphs are devoted to describing the engineering change procedure presently in use, the effects which present procedures have on the V.E. program and the conclusions to be drawn about corrective actions which can be taken. The material is based both on personal visits to elements of DOD and industry and on the responses received from a detailed questionnaire sent to a large segment of defense industry. Exhibit 25 is a copy of the questionnaire used. Exhibit 26 lists those who submitted answers to it.

1. <u>Description of the Engineering Change Procedure</u>

a. <u>Scope of the Engineering Change Procedure</u>

For the purpose of this report, the change procedure as applied to V.E. changes includes all actions taken from the time a V.E. group submits a recommended change for internal management evaluation and review, through formal submission for Department of Defense evaluation, to final approval - including initial planning for implementation.

b. Elements of the Change Procedure

The elements of the engineering change procedure, as far as V.E. is concerned, can be grouped into three broad categories. One embodies the decision-making actions - the management review - of V.E. proposals. The second concerns the physical handling and transmittal of the data and facts about the change. The third category is that part of the procedure related to control, direction and monitoring.

(1) Management Review

Although the basic elements of the review part of proposal preparation and evaluation have been covered in the section of this report dealing with the methodology of value engineering, it is worth restating that evaluation for technical and economic feasibility is the basic purpose of the engineering change procedure when applied to V.E. proposals. Further, it is important to recognize that evaluation takes place two more times after the initial evaluation by the V.E. group which developed the proposal. It is in these later review efforts - one by the contractor and one by the customer (Department of Defense) - that effective change action is or is not accomplished.

(2) Data Handling

Each V.E. change proposal contains data and documentation supporting its recommendations. With even the simplest change, a substantial amount of data are involved. As the proposal moves through the various steps in its review, more data are accumulated. The total amount of data, and the number of handling points, become of great significance to the entire change procedure.

Further, the data connected with a given V.E. proposal move across departmental lines in the originator's

and the customer's organizations. This, too, compounds the change procedure data handling problem.

(3) <u>Controlling the Engineering Change Procedure</u>

The change procedure must be controlled to ensure product integrity, for without some sort of check on the change procedure, the process can easily get out of hand. This is of great significance to modern weapons systems. Composed as they are of thousands of subsystems and hundreds of thousands of parts, they are particularly susceptible to compromise by an out-of-control change procedure. For example, without detailed records and a very firm control on changes, it is quite possible that no two weapons would be alike and, further, that no one would know how they differed. The problems of maintenance, logistics support, interpretation of test results, etc., that this would lead to (and has led to) are readily apparent. For just such reasons, the configuration control concept was developed.

All of the preceding elements merge and overlap. As would be expected, the change procedure is complex, not only conceptually, but also procedurally. This fact itself contributes to the present status of the change procedure.

2. <u>Effect of Present Change Procedures on the V.E. Program</u>

The reasons previously given for processing V.E. proposals through the engineering change procedure can be summarized as follows: to assure that real benefits will result from the proposal if approved and implemented and that approved proposals are translated into practice in a prompt, efficient and controlled manner. The findings and conclusions concerning the effect of the engineering change procedure, as presently constituted, on value engineering are described below.

a. Assuring Real Benefits

In almost every instance, the V.E. study indicated that the engineering change procedure fulfilled its primary purpose of evaluating V.E. proposals thoroughly and objectively to assure their technical and economic feasibility, hence, their ability to provide real benefits to defense products when implemented.

The only significant problem area uncovered involved a few isolated cases in which valid reasons existed for disapproving a V.E. proposal, but were not communicated to the originator. Thus, what on the surface appeared to be cases of capricious and erroneous evaluation in reality were cases of poor communication and government-contractor cooperation. The conclusion to be drawn is that two-way communication and full disclosure of pertinent facts should be a standard operating procedure in all reports of the status of V.E. proposals in the course of their evaluation in the engineering change procedure, especially if a V.E. proposal ultimately must be disapproved.

Overall, it is concluded that the engineering change procedure does, in fact, provide the required assurance that V.E. proposals lead to real benefits. It is further concluded that no serious thought should be given to establishing a new or separate change procedure to process V.E. proposals only, independently of existing procedures.

b. Promptly Translating, in a Controlled Manner, Valid Proposals into Practice

The ability of the engineering change procedure to translate V.E. proposals into reality in a controlled manner was clearly demonstrated during the course of the V.E.

study, virtually without exception. Thus, this aspect of the engineering change procedure is not considered to be a problem area.

The ability of the change procedure to react and respond quickly was not demonstrated and, in fact, was found to be inadequate and a major impediment to an effective V.E. program.

The data which were obtained concerning engineering change proposal processing times are presented in tabular form in Exhibit 27 (Contractor Processing) and Exhibit 28 (Government Processing).

It should be noted that the data obtained apply to all engineering changes, not just to those generated by value engineering.

(1) Analysis of Exhibit 27

In all cases, changes with the equivalent of an "Emergency" classification received greatly expedited flow through the contractors' change organizations. Contractor processing time for Emergency changes ranged from a low of one (1) day to a high of ninety (90) days, with ten (10) days the average. For the "Urgent" category of change proposals, the range of processing times, as well as the average, is approximately three (3) times as great as that spent on Emergency category changes. Changes classified as "Routine" appear to require excessive time for processing. Although a few companies (which either are further into the production cycle and/or which generate fewer changes) have been able to hold the processing time to a reasonable limit, most have not. Average contractor processing times and longest times of sixty-one (61) and one hundred and forty-five (145) days respectively

represent major delays. The range on Routine changes of as little as one (1) day to as much as three hundred and sixty (360) days is indicative of both the severity of the problem as well as its lack of uniformity, caused in part by the variation in complexity of the changes themselves and in part by variations in the effectiveness of the change procedures used.

(2) Analysis of Exhibit 28

Governmental review and approval time on proposed engineering changes far exceeds contractor time for the entire failure or deficiency analysis, corrective engineering, internal approval and submission cycle, as is clearly shown in Exhibit 28. Average government processing time on Emergency engineering changes is twenty-three (23) days. Compounding the problem are government average processing times of ninety-six (96) days and one hundred and eight (108) days respectively for Urgent and Routine changes. The largest time figures of one hundred and eighty (180) days, five hundred and forty (540) days and seven hundred and twenty (720) days in decreasing order of priority classification would suggest that some changes for all practical purposes become lost in the maze of governmental processing.

In virtually every organization contacted in DOD and industry, it was found that V.E. changes are given a Routine priority in the change procedure. Of itself, this is not necessarily incorrect or poor practice, because the higher priorities generally are reserved for changes of a serious and urgent nature, such as those involving safety of personnel and property, or those required to make hardware operationally ready for service. However, time is of the essence in obtaining tangible cost reductions from V.E. proposals and the

fact that Routine changes, including V.E. changes, take so long to process indicates that the engineering change procedure is definitely a major impediment to the V.E. program.

Because of the severity of the processing time problem, the change procedure was subjected to further in-depth study and analysis.

First, the ability to process changes rapidly on occasion was clearly demonstrated by the data shown in Exhibits 27 and 28, both for Emergency changes, as well as for Urgent and Routine changes, since times of as little as one (1) day were reported for all categories. Thus, it is concluded that rapid processing is not inherently impossible.

Second, investigation disclosed that value changes as a matter of course receive last priority in processing and further, when they finally are processed, are put through the change procedure on a random basis, regardless of relative urgency or savings potential in them.

Third, in a few cases where engineering change procedures were very carefully structured and controlled, the ability to process most changes rapidly was clearly apparent. An example of one such approach is the "Quick Fix Cycle" developed for Minuteman, shown in Exhibit 29. Although this is a tailor-made procedure for specific application to a particular weapon system, it was concluded that the elements of procedural definition and streamlining, continuous control and fixed responsibility inherent in the "Quick Fix Cycle" are applicable to all engineering change procedures.

Fourth, in a number of cases it was found that the responsibility for excessive delay in processing V.E.

proposals was clearly that of the originator, either because of his delay in completing internal evaluation, or because of not providing adequate data with which to evaluate the proposal. It was concluded that originators must be prompt and thorough in the preparation and review of their V.E. proposals and pay special attention to documenting their proposals completely.

Finally, in some instances it was found that basic hard-core problems involving all changes were responsible for delays. Pending solutions for them, little can be done to improve the situations where they apply. It should be noted that an LMI study of all of these basic problems is currently in progress.

3. Corrective Action Needed

On the basis of the results of the V.E. study of the change procedure, it is considered that:

a. The basic structure of the engineering change procedure currently in use, insofar as it pertains to the evaluation function, does not need to be changed because it provides adequate and effective assurance that a V.E. proposal is feasible.

b. There is no good reason to seriously consider processing V.E. changes through any procedure other than established engineering change procedures, because the present procedures can be satisfactory, because the cost of establishing duplicate procedures would be excessive and, finally, because split responsibility for changes would result - a situation not compatible with the configuration control concept.

c. Concerted action to speed up the processing of V.E. proposals through the change procedure is urgently needed. Two broad courses should be taken:

(1) Conduct intensive studies of the total overall change situation to find solutions to the hard-core, basic problems which indirectly, and at times directly, affect V.E. changes. A current LMI priority project is directed at this end.

(2) In the interim, take steps to:

- Upgrade the priority (or relative importance) of V.E. proposals, based on their urgency, ease of evaluation and savings potential; and
- Adapt, wherever possible, the procedural improvements typified by the "Quick Fix Cycle" (Exhibit 29) to other change procedures. At a minimum, attempts should be made to establish specific responsibilities for required actions, to streamline flow paths, to establish and enforce time limits for actions, to allocate resources on a basis commensurate with return and to use expeditious data handling techniques.

While it is admitted that the total engineering change problem is very complex and difficult and will require intensive study before solutions to it can be developed, it is believed that adoption of the preceding will lead in the interim to marked improvement in the processing of most V.E. proposals.

H. INCENTIVES AND MOTIVATION FOR VALUE ENGINEERING

As previously shown in this report, it is not easy to bring about significant cost reductions through value engineering. V.E. challenges the status quo, never too popular

an endeavor; V.E. reduces costs, seldom a result greeted with enthusiasm by those directly affected; V.E. second-guesses someone's hard work and creative efforts, a touchy business at best; and V.E. even attacks the validity of the customer's concept of what he believes he really wants and needs to buy. Thus, it is not surprising that even well-conceived, soundly organized V.E. programs are relatively ineffective if motivation to do a good job is lacking.

This section is devoted first to a description of the present approaches to providing motivation for V.E. efforts in DOD and industry and the relative effectiveness of these approaches and, second, to the conclusions derived from the study about new or revised approaches to motivation needed to obtain superior V.E. efforts.

1. Effectiveness of the Present Approaches to Motivating Value Engineering

To restate explicitly what has been implied throughout most of this report, an effective V.E. effort requires the active participation and cooperation of a number of people in different environments with different purposes and duties. Value engineers, program managers, technical specialists and configuration control groups in the Department of Defense; value engineers, technical staffs and managers in industry are just a few of the diverse skills and personnel involved. Motivating superior performance from all personnel concerned, as well as the organizations of which they are members, requires the provision of incentives appropriate to the need and circumstances of each.

Part of the data developed during the course of the V.E. study concerning motivation and incentives is summarized in Exhibits 30, 31, 32 and 33.

Exhibit 30, "Analysis of Current Motivational Techniques for Value Engineering Practiced by DOD and Industry," presents the ratings of effectiveness and frequency of application for twenty-eight techniques. The ratings are made for each motivational method when applied by DOD and when applied by industry, when such dual application is possible or practiced. It should be noted that it was not possible to categorize the effect of the motivational techniques any more specifically than as "Average," "Superior," or "Negative." The classification assigned to each technique is purely the opinion of people who are not trained in motivational psychology. The assessment was performed by experienced value engineering management personnel who are capable of estimating the specific effect upon value engineering programs. Undoubtedly the criteria could be improved.

The frequency of usage rating assigned to each technique reflects the extent to which it actually reached and was used by the person or persons in position to take the necessary implementing action. For example, AFPC 16, as a DOD type "Directive' form of motivation, was rated as rarely used. Even though this document has received the wide dissemination of standard Air Force Procurement Circulars, its direct application and implementation has been relatively infrequent.

Exhibit 31, "Distribution of the Motivational Techniques for Value Engineering Currently in Use by DOD and Industry," shows the relationship between the number of methods employed and their effectiveness. It can be seen that of the twenty-one motivational techniques practiced by industry, sixteen are rated average and eight are rated superior. For the DOD, the situation is reversed; eleven of the eighteen techniques are rated superior when applied by DOD.

Exhibit 32. "Frequency of Usage of the Superior Value Engineering Motivational Techniques. illustrates that of the eleven superior DOD techniques, eight are used rarely, two are used moderately and only one is considered to be widespread. Industry shows a better balance of its five techniques that are rated as superior: one is used rarely, three moderately and another is used widely.

The "Frequency of Usage of the Average Value Engineering Motivational Techniques," Exhibit 33, shows that industry is making widespread usage of seven of its sixteen techniques rated as average. DOD is more restrained in usage of the average methods, but this is also typical of its usage of the superior techniques.

An analysis of the significance and importance of the preceding data and of additional facts and opinions obtained during the V.E. study is presented below, first for the Department of Defense and then for defense industry.

a. Incentives and Motivation within the Department of Defense

Within the Department of Defense there are two composite groups concerned with V.E. One group consists of people: the management, technical, procurement and fiscal staffs associated with the various procurement or industrial activities who provide the environment for the V.E. effort, make the final evaluation of V.E. proposals and, in some cases, perform the value engineering studies. The other group is made up of the organizations concerned with product value, such as arsenals, shipyards and procurement activities.

(1) Personnel

For civilian personnel in DOD, one of the strongest motivations for V.E. effort is career advancement

through merit promotions. Such promotions, however, are relatively rare. Moreover, few specific, direct career patterns have been established for those in value engineering. This, coupled with the fact that direct financial reward outside of token awards is not presently possible, leads to the conclusion that action is required to establish the desirability of a career in V.E. by the establishment of a value engineering job series in the position classification system.

Management support and attention to V.E. were found to be very important motivating forces for the V.E. program, especially in view of the career problems. Motivating management support is a problem in itself, but in most cases where such support existed, above-average results were obtained from the V.E. program. Exhibit 34, for example, indicates the diversity in results obtained from different shipyard V.E. efforts. In the opinion of those familiar with the causes of such diversity, the major one is management attitude toward the V.E. program. Almost every person in value engineering contacted during the course of the V.E. study stated that management support is vitally important but, for the most part, sorely lacking. The V.E. study concurred in this conclusion but, as was noted earlier, believed that management's attitude was in many cases justified.

The problem, therefore, is not only to motivate the direct participants in value engineering but also to motivate top and middle management.

It is not possible to provide direct financial incentives to government management personnel. Nevertheless, shipyard or arsenal commanding officers, procurement managers and system directors are evaluated on the efficiency of their

organizations, even though the emphasis on the cost elements of their activities is not as strong as it is in private industry. There are indirect ways and means, such as fitness reports, evaluations for promotion and public recognition, to focus attention on the financial aspect of performance. Although the Department of Defense cannot be operated or judged in the same profit-oriented manner as private industry, a specific re-emphasis of the importance of cost considerations should be made, especially as value engineering contributes to them.

(2) Organizations

Until recently, little direct motivation existed for doing value engineering in the Department of Defense as a whole or in major organizations within it. Most of the motivation was essentially permissive at best, rather than mandatory. Examples of this situation were the lack of firm DOD policy statements on V.E., the weak approach to V.E. in ASPR and in Department implementing instructions and the absence of targets and goals for value engineering.

In recent months significant efforts have been made to correct these deficiencies. The current DOD Cost Reduction Program, the revision to ASPR and increased direct attention to V.E. by OSD are all extremely important and useful as means of motivating superior efforts in value engineering. Thus, it is concluded that no serious problem presently exists in providing, to DOD as a whole and to its major organizations, motivation for doing effective value engineering.

b. Incentives and Motivation within Defense Industry

As with the Department of Defense, it is necessary to distinguish between those motivating forces directed

at personnel and those applied to organizations (contractors) and defense industry as a whole.

(1) Personnel

Virtually the same techniques employed in DOD to motivate personnel are used in defense industry. In addition, the same types of problems, including nearly unanimous complaints from V.E. personnel about the lack of tangible management support (again, often for good reason) were in evidence.

Thus, it was concluded that similar corrective action is needed in defense industry. Incidentally, it is believed that industry should be able to move ahead faster and farther than DOD in taking such action because private industry has more flexibility than DOD in matters of promotion, evaluation, raises, career enhancement and speed of management action. Additionally, industry has greater opportunity and authority to make financial awards and bonuses, thus, industry should lead the way in improving motivation to do V.E.

The same motivating forces were found to apply to industry management as to DOD management. In addition, however, industry management is directly concerned with profit, return on investment, sales and the other elements of competitive, profit-oriented business operations. It was concluded that the best way to motivate defense industry management was to make successful value engineering efforts profitable for defense industry, both in terms of increased sales and increased profit margins.

(2) Organizations

It was found that three major factors influence defense contractors' V.E. efforts: (1) desire to be competitive

in price and in management capability; (2) desire to satisfy DOD's wishes and desires, i.e., to "please the customer;" and (3) the desire to increase the profitability of company operations.

Unfortunately, up until now little real motivation based on these three elements has been applied to defense industry, with the result that only a minimum of effort has been devoted to V.E. by industry. This in turn accounts for the fact that V.E. has barely begun to achieve its potential as a significant, major cost reduction tool for the Department of Defense.

Because of the severity of the problem and the urgent necessity for sound and prompt corrective action, it is believed that this aspect of the motivation problem warrants full and detailed treatment.

(a) V.E. as a Competitive Tool

No cases were found during the course of the V.E. study where the existence or non-existence of an effective, proven V.E. program played a part in contract awards. Undoubtedly, some cases do exist; nevertheless, the fact that none were uncovered during the V.E. study is considered prima facie evidence that this aspect of V.E. motivation has been sorely neglected.

The preceding is not meant to imply that no cases were found where value engineering was a contract requirement - many such situations were, in fact, apparent. The point is that past history and demonstrated effectiveness in V.E. did not play a part and were not considered in awarding contracts, thus, value engineering per se did not contribute to company competitive position. It is concluded that greater

attention to demonstrated cost effectiveness, specifically including value engineering efforts, is necessary in awarding contracts to defense industry. It should be pointed out that the current emphasis on competitive procurement will exert increasing pressure on cost effectiveness and thus will provide greater motivation for value engineering.

(b) V.E. as a Method for Satisfying DOD Requirements

Little evidence was found during the course of the V.E. study to show that contractors consider the performance of V.E. a useful means for achieving customer satisfaction and therefore establishing better relations with DOD. For example, in almost every case where V.E. was made optional on contracts, with no financial incentives provided for its accomplishment, no effort resulted. It seemed apparent that the desire to please the customer through this method was not very strong, mainly because the customer actually did not seem particularly interested in getting such efforts. It was concluded that much stronger evidence of DOD interest in V.E. was needed through appropriate directives, policy statements and publicity. One of the best methods for showing such interest is considered to be the current DOD Cost Reduction Program with its specific emphasis on goals for value engineering.

(c) V.E. as a Profit-making Tool

The ability to earn extra profit is one of the strongest motivating forces for doing value engineering. In commercial work, for example, it was found that the only significant reason for doing V.E. is its effect on profit. In fact, the most successful V.E. programs were found in non-defense companies dealing in highly competitive products - where profits depend to a great extent on maximum efficiency

and continuous attention to costs through such techniques as V.E. It is important to note that the V.E. effort in non-defense businesses is strictly under the control of each business, with all savings accruing to the originator. Such is not the case in all instances for V.E. done by defense contractors, because in many cases contract modifications or changes are required - thus DOD approval (and DOD participation in savings) is necessary. Thus, it seems that V.E. is inherently more difficult and less rewarding to do on government business than on commercial work.

Notwithstanding the difficulty, many attempts are being made to motivate defense contractors to do V.E. Two different methods are being used at present to provide such motivation: (1) voluntary programs with sharing of savings generated by the V.E. effort; and (2) required programs funded directly by the government. Because a number of factors, such as the responsiveness and speed of the change procedure and the degree of management support affect V.E. efforts, it is difficult to isolate the part that financial incentives alone play. Nevertheless, an in-depth analysis of the data available led to the following conclusions.

First, contractors are favorably motivated to do V.E. on a voluntary basis by the saving-sharing approach if two conditions are met. One is that V.E. return a reasonable profit, i.e., a return commensurate with the risk and effort involved, similar to the returns from available alternative investments. The other is that V.E. efforts produce real savings, i.e., lead to proposals which are evaluated fairly and <u>promptly</u>, so that they can be implemented quickly and lead to actual savings for the contractor to share. Most contractors,

it should be noted, do not believe that this latter condition is generally being met today.

Second, contractors are motivated to do V.E. by the program requirement approach. They have no choice but to do V.E. in such circumstances. The quantity and quality of results, as would be expected, varies widely. Since reward is not tied to achievement, it is believed that this approach is less than optimum. Nevertheless, it has its uses and can be effective provided that close monitoring and direction are given to it.

Third, the attention to the cost effectiveness of the V.E. effort itself varies directly with the financial involvement of the organization doing V.E. That is, those organizations which pay for V.E. out of their own pockets monitor expenses closely, check on savings generated very carefully and, in general, require V.E. to stand on its own results. Much less careful and critical approaches are taken by those organizations which do not fund the V.E. program on their own. It is concluded that the best approach to V.E. is the former; if the latter is used, careful external monitoring and control is necessary to assure equivalent results.

Fourth, all companies engaged in value engineering are aware of the many factors other than initial cost which play a part in product value. Although increased performance by definition is not considered to be the province of V.E., all other aspects of value are. They include such factors as maintainability and logistics support. In short, they can be summed up as all elements of total cost. It was concluded that this point in performing, evaluating and rewarding V.E. was of major importance.

Fifth, throughout DOD and defense industry a great deal of concern was expressed about overly complex and demanding control, auditing and reporting requirements connected with V.E. Further, many considered such requirements to be strong reasons for not doing V.E. It was concluded that although these requirements are demanding and irksome, they are necessary. More uniform approaches, based as much as possible on existing contractor systems, certainly are desirable. The only way to avoid most of the requirements, however, would appear to be to have contractors fund, hence control, V.E. completely on their own - rather than with DOD money.

Sixth, it was found that a great deal of concern exists throughout defense industry about their ability to retain savings generated by their V.E. efforts. Specifically, they are concerned about renegotiation, statutory fee limits and adverse results from combining the basic incentive provisions of incentive contracts with V.E. incentives. It is concluded that although there theoretically is basis for such concern, the actual savings generated to date from V.E. efforts are not nearly large enough to warrant serious consideration of the above problems at the present time.

c. General Conclusions on Motivation and Incentives for DOD and Industry

In general, LMI concluded from its study of V.E. motivation and incentives that:

(1) Effective motivating techniques for personnel in both DOD and industry are available but are not in widespread use nor used to greatest advantage;

(2) Effective te[illegible]ues, such as the Cost Reduction Program, are available [illegible] currently are being used to

advantage to motivate DOD as a whole and major organizations within DOD; and

(3) Effective motivating techniques for industry as a whole and for individual companies are available but have not been used to any great extent. In addition, the financial incentives actually in current use appear to require revision if they are to achieve optimum results.

2. Improvements Needed

As this section indicates, improvement in providing motivation for the accomplishment of value engineering is necessary for personnel in DOD and industry. Further, better motivation, especially through the use of financial incentives, is required if industry is to meet its goals in the V.E. program. Conclusions concerning the actions required are presented below.

a. Personnel Motivation

Items 5 through 28 of Exhibit 30 list most of the techniques available to DOD and industry for motivating superior value engineering efforts. As can be seen, the techniques fall into three broad categories: (1) management support; (2) career enhancement; and (3) general publicity and acknowledgement of V.E. as a cost reduction technique and of particularly successful V.E. accomplishments. It should be apparent that (2) and (3) are directly dependent on and follow from (1); that is, management support to value engineering will lead both to the establishment of V.E. as a desirable, rewarding career and to effective publicity about V.E., its goals and its accomplishments.

Thus, LMI concludes that the most important action required to motivate V.E. among DOD and industry personnel is

to give V.E. continuing top level support and encouragement while at the same time setting and demanding high levels of performance and output from V.E. personnel. Management support, of course, should primarily be active rather than passive. Major emphasis should be placed, therefore, on making V.E. an attractive career to superior personnel. Much improvement in this area is necessary. Passive support consists of the use of appropriate publicity. DOD and industry can and should improve their use of publicity, both qualitatively and quantitatively.

b. Industry Motivation

The desire to be competitive and to please the customer are important motivating forces for companies because they affect companies' ability to get future business. As was found during the V.E. study, these forces have not been used to advantage by DOD in the past. What is required is first, strong policy statements by DOD that V.E. is not only expected but virtually mandatory for defense suppliers and second, that the existence of effective, proven V.E. programs will be a factor in determining contract awards.

While the preceding is important, the strongest motivating force for industry is direct financial incentives which lead to greater profit on new and existing business. The goal, in line with OSD basic policy, should be to reward efficiency and penalize waste. Therefore, extra profit to industry should only follow from significant net total cost reduction to DOD. Thus, the preferred approach to V.E. financial incentives is savings-sharing, with the contractor funding, controlling and performing V.E. as he deems appropriate. Only under certain special cases, to be discussed below, should the DOD funded, required program approach be used.

Because of the complexity of DOD procurement methods, the specific approach to V.E. incentives is also complex. To ensure an adequate understanding of the problems involved, a detailed discussion of the LMI suggested incentive approach, summarized in Exhibit 35, follows. For simplicity, treatment is broken down by contract type.

(1) CPFF Contracts

Because of their nature, CPFF contracts do not instill or reward cost consciousness. Further, because CPFF contracts often cover developmental and prototype production work, any action taken to increase product cost effectiveness has significant, long-term benefits. For these reasons, such contracts are excellent candidates for effective value engineering. In accord with the conclusions previously discussed, then, a strong incentive based, if possible, on the sharing principle should be applied to these contracts.

At the same time, however, it is necessary to recognize that costs in a CPFF contract must be controlled to prevent "empire building." Thus, the LMI incentive approach provides for a funding limit based on contract size and anticipated return. Finally, because DOD is entitled to maximum return on the added costs which V.E. funding engenders and also because the element of financial risk to contractors is small in cost contracts, the LMI approach provides that the sharing principle does not operate until the V.E. effort develops approved savings in excess of five times the total amount of funding.

The inclusion of a required V.E. program in CPFF contracts is left to the option of the contracting officer because many cost contracts cover basic research, feasibility

studies, etc., and thus are not suitable applications for value engineering.

In order to equate the funding level on CPFF contracts with a reasonable and probable return on the funding investment, it is necessary to limit V.E. in most cases to those CPFF contracts over $1 million (annual expenditure).

It is important to note that the contractor's share of V.E. savings is included in determining contractor fee. Since there are statutory limits on fee in CPFF contracts, the V.E. clauses in these contracts must reflect such limitations.

(2) CPIF Contracts

The CPIF type of contract is often used under circumstances similar to those requiring CPFF contracts, though usually further downstream in a product's life cycle. Thus, many of the same arguments cited under CPFF Contracts above regarding the need for V.E. apply here.

CPIF contracts, in contrast to cost-plus-fixed-fee contracts, are designed to provide contractors with an opportunity to earn a fee based on how well they perform the contract. Although delivery and product performance may be included as incentive factors in such contracts, primary importance is often placed on cost control. Thus, by its very nature, a CPIF contract provides an incentive to the contractor to perform V.E. (of the kind not requiring government approval) since the savings generated can be applied in total to reducing costs, thus, to earning higher fees.

Much less incentive exists for doing V.E. which requires government approval, because of the increased

risk and effort required by the contractor. Further, the basic point of an incentive-type contract is to get top performance on the contract as written, not as the contractor feels it should have been written. In accordance with the conclusions of this report, then, and in harmony with the intent of the incentive contract itself, it is desirable to apply saving-sharing to these contracts. Further, to make approval-required V.E. attractive to the contractor, the savings ratio must be such that larger rewards are earned than those obtainable by doing non-approval-required V.E. For this reason, a ratio of 50%-50% is usually required.

The funded effort approach to V.E. is not generally required on CPIF contracts because the incentive fee provisions themselves act as a brake on contractor spending. Thus, the contractor will only fund as much V.E. effort as he finds worthwhile. In addition, since the contractor is taking the risks and the rewards of the V.E. effort, he should have as much control over it as possible. If necessary, however, because of special conditions such as a potential overrun situation, the funded effort approach may be used.

Contracts under $100,000 generally are not to be covered by V.E. because of the relatively small return, on the average, which they would generate. It is not felt to be worth the administrative cost and effort which would be required by the government in evaluation, negotiation, change order effort, etc.

On contracts over $100,000 to which the sharing-saving approach is applicable, the return is more likely to be worth the effort. For this reason, inclusion of V.E. clauses should be a mandatory requirement of contracting officers. For

contracts requiring funded V.E., the return is worthwhile only on contracts over $1 million. Use of a program requirement clause for V.E. is considered mandatory in such cases.

The same statutory limits of fee mentioned above under CPFF contracts also apply to CPIF contracts and thus the V.E. clauses in CPIF contracts must reflect these requirements.

(3) <u>FPI Contracts</u>

Unlike CPIF contracts, FPI contracts contain a fixed limit on price. Therefore, the funding limit technique should never be necessary because the contractor will only fund V.E. to a level appropriate to return generated. The saving-sharing approach, on a 50%-50% basis, should provide adequate incentive for V.E. in FPI contracts.

It is suggested that V.E. only be applied to FPI contracts over $100,000 since the return to the government to be expected from smaller contracts probably would not cover the government's expense in evaluating and implementing the proposals submitted.

(4) <u>Fixed-Price Contracts</u>

(a) <u>FFP Contracts</u>

FFP contracts are usually applied in the production and follow-on stages of a product's life cycle. At this stage, V.E. is harder to apply because of the complexity of the change process. Nevertheless, it can make important cost reduction contributions both by applying new technology to older products and also by re-examining the specifications for the products. Thus, V.E. is clearly applicable to the FFP situation. The preferred incentive again is the sharing method.

It is important to remember, however, that contractors quite logically prefer to do non-approval-required V.E. over approval-required V.E. on fixed-price contracts. Therefore, the sharing ratio for approval-required V.E. should be at least 50%-50%. Experience may indicate that an even higher share to the contractor is necessary to stimulate a worthwhile V.E. effort, perhaps as much as 75% to 80%.

Funding is not appropriate in these contracts because their competitive nature will act to limit the contractor's V.E. effort to an amount commensurate with proven return. Again, because V.E. has proven to be valuable to FP contracts, clauses encouraging its use should be mandatory on contracts of appropriate size, namely, those over $100,000 - unless the products involved are purely commercial items with prices set by competitive forces in a free market.

It should be noted that all savings for non-approval-required V.E. accrue to the contractor. It is anticipated that competitive pressures will eventually lead contractors to share some of these savings with the government through reduced prices and lower bids.

(b) FP Contracts with Escalation

The same conditions and considerations listed above for FFP Contracts apply equally to FP contracts with provision for escalation. Therefore, the same formulas should be applied to both. However, the escalation provisions of these contracts should not be used in any manner which would reduce the contractor's share of savings earned through his value engineering efforts.

(c) FP Contracts with Redetermination

In theory, FP contracts with redetermination provisions are quite similar to FP contracts. In practice,

however, these contracts are often used where costs are not well known. In such situations, V.E. often can made significant contributions and appropriate incentives for its use should be provided. The preferred choice is through saving-sharing. As with escalation contracts, it is imperative that the redetermination procedure not be used, or applied, to reduce the savings share which the contractor earns from his V.E. efforts.

III. RECOMMENDATIONS*

In order to achieve the full savings potential from the application of the value engineering technique throughout the defense-industry complex, it is recommended that the Department of Defense:

1. Issue a strong policy which will reinforce the Department of Defense's already stated endorsement of the value engineering program.

The specific emphasis of this policy should be placed on the expansion of the use of the value engineering technique to all areas where it can be productive. The policy should require that the military departments and Defense Supply Agency report back the extent of the actions taken.

2. Provide clear and tangible evidence of the continuing interest in and support of value engineering by the DOD through the scheduling of visits by top level DOD officials to a number of defense contractors.

The purposes of these visits would be to convey at firsthand the officials' interest in value engineering and to make inquiries about the progress in the implementation of V.E. programs within the contractors' establishments. An effort should be made to visit at least twenty-five of the

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*The recommendations set forth in this section have previously been presented to OASD (I&L). They are, as of the date of this report, either already implemented, in the process of implementation, or under consideration by OASD (I&L).

major prime defense contractors. A letter to the selected contractors from the Secretary of Defense, either prior to the visit stating the purpose of the visit and requesting cooperation, or after the visit thanking the contractor for his cooperation and congratulating those who exhibited progress toward the objective, would greatly enhance the value of these visits.

3. Revise the Armed Services Procurement Regulation to provide direct and substantial financial incentives to defense contractors for the successful performance of V.E.

The guiding principle of these incentive provisions should be financial reward based on actual results achieved, risk taken and relative return on investment. Since value engineering is a dynamic technique and is still in the development stage, the ASPR V.E. incentive provision should be updated and revised from time to time to reflect any improvements in measurement standards, cost accounting techniques, engineering change procedure processing methods or any other new developments in the value engineering technology. Experience with the use of the V.E. incentive provisions will also undoubtedly provide additional inputs for revising and modernizing the ASPR provision.

4 Provide strong systems of program control which will set targets, measure progress against those targets and obtain qualitative analyses of the value engineering programs in operation both in DOD activities and in contractor establishments.

The targets established by the DOD would be broken down among the three military departments and Defense Supply Agency and then further sub-divided within the departments

by commands, bureaus and major producing and procuring activities. The targets so established would distinguish between those savings which can be achieved completely in-house and those which must be achieved through defense contractor efforts. In order to measure progress against the established targets, a reporting system should be implemented which would adequately reflect progress against the targets and would also supply sufficient information for management corrective action wherever required. In addition to the program control data provided by the reporting system which would be essentially quantitative in nature, an audit system should be established to provide qualitative analyses of both DOD and contractor V.E. programs. The targets, reporting systems and audit systems should be tied in to the overall DOD Cost Reduction Program, but should be somewhat more detailed at the operating level than that required to meet the needs of that program. In effect, then, they would become input devices to the data accumulation systems of the DOD Cost Reduction Program.

5. Develop improved training programs and provide or sponsor the establishment of training facilities.

These actions would be designed to:

a. Upgrade the professional competency of present value engineers; and

b. Substantially increase the supply of qualified practitioners of value engineering.

These training programs would concentrate on advancing the state-of-the-art of V.E. and would emphasize the imparting of technical substance as distinguished from the "propaganda and bally-hoo" type of orientation now found to

be so prevalent in existing V.E. training programs. Training for defense contractor personnel would, of course, be dependent upon voluntary participation on the part of defense contractors.

6. Publish a Value Engineering Handbook which would serve as a guide to establishing successful value engineering programs.

The V.E. Handbook would define the scope and substance of the V.E. program with particular emphasis on description of the methodology, standards for selecting items for V.E. study, methods of organizing the V.E. function and establishing the appropriate levels of effort, methods of training value engineers and procedures for controlling the V.E. program once it is established. In addition to providing the general framework of the V.E. program, the Handbook would be so designed as to be useful as instructional material in training programs. The Handbook should be given wide distribution throughout the defense-industry complex and should be periodically updated to reflect new developments in value engineering.

7. Provide on-site implementation assistance to DOD producing and procuring activities and also provide the same assistance to defense contractors upon request.

This on-site assistance should be provided by teams of highly qualified personnel who are familiar with the requirements of the V.E. program and with the specific technologies to which the program applied. It will be necessary for the DOD to provide intensive training for the personnel who will be assigned to the implementation teams.

8. <u>Issue a Value Engineering Specification which would establish minimum standards for the performance of value engineering under program requirement clauses in defense contracts</u>.

The V.E. Specification would provide guidelines to defense contractors who are required to perform a value engineering function which is funded by the government. The Specification should not be so rigid as to be unduly restrictive on the contractors' initiative and creativeness, but rather should set base line performance standards which the contractors will be required to meet. The V.E. Specification should be issued as a fully coordinated standard, thereby bringing a degree of uniformity to the value engineering program requirements of each of the military departments and the Defense Supply Agency.

EXHIBITS

DRAFT OF PROPOSED POLICY

Secretary of the Army;
Secretary of the Navy;
Secretary of the Air Force;
Director, Defense Supply Agency.

Value engineering has proven to be an effective tool for reducing the costs of defense products without adversely affecting their performance. Despite the fact that value engineering has been applied throughout the military departments and DSA and has produced substantial savings to date, it has not yet achieved its full potential. It is the policy of the Department of Defense to expand the use of this technique and to utilize it wherever it can be profitably employed.

I therefore request each of you to take action to ensure that value engineering is being applied productively and aggressively wherever appropriate within your department.

I have designated the Assistant Secretary of Defense (Installations and Logistics) as the DoD-wide coordinator of all value engineering activities. Specific details as to the types of value engineering programs I want implemented will be provided by ASD (I&L).

Each of you is requested to furnish me, within 90 days of the date of this document, a report of the actions you have taken to implement this policy.

Robert S. McNamara

LIST OF ORGANIZATIONS CONTACTED

Industry

A. B. Dick Company
Chicago, Illinois

Aerojet General Corporation
Sacramento, California

AiResearch Manufacturing Company
Los Angeles, California

Allis-Chalmers Company
West Allis Works
West Allis, Wisconsin

American Machine and Foundry Company
Stamford, Connecticut

Bendix Corporation
Burbank, California

Bendix Corporation
Towson, Maryland

Boeing Company
Seattle, Washington

Douglas Aircraft Company, Inc.
El Segundo, California

Emerson Electric
St. Louis, Missouri

Fairchild Camera and Instrument Corp.
Syosset, New York

Federal Pacific Electric Company
Newark, New Jersey

General Dynamics Corporation
Convair Astronautics Division
San Diego, California

General Dynamics Corporation/Ft. Worth
Fort Worth, Texas

General Dynamics Corporation/Pomona
Pomona, California

General Electric Company
Hotpoint Division
Chicago, Illinois

General Motors
Euclid Division
Hudson, Ohio

General Precision, Inc.
GPL Division
Pleasantville, New York

Goodyear Aircraft Corporation
Akron, Ohio

Hoffman Electronics Corporation
Los Angeles, California

Hughes Aircraft Company
El Segundo, California

International Telephone and Telegraph Corp.
ITT Kellogg Communication Systems Department
Chicago, Illinois

Itek Corporation
Lexington, Massachusetts

Litton Systems, Inc.
Woodland Hills, California

Lockheed Aircraft Corporation
Lockheed - California Company
Burbank, California

Lockheed Aircraft Corporation
Lockheed - Georgia
Marietta, Georgia

Loral Electronics Corporation
New York, N.Y.

Martin Company
Martin-Marietta
Baltimore, Maryland

Martin Company
Martin Orlando
Orlando, Florida

Minneapolis Honeywell Corporation
Minneapolis, Minnesota

Motorola, Inc.
Electronics Division
Chicago, Illinois

Motorola Radio Corporation
Scottsdale, Arizona

North American Aviation
Los Angeles, California

North American Aviation
Autonetics Division
Downey, California

North American Aviation
Rocketdyne Division
Los Angeles, California

Northrop Corporation
Norair Division
Hawthorne, California

Packard-Bell Corporation
Los Angeles, California

Radio Corporation of America
Camden, New Jersey

Raytheon Company
Lexington, Massachusetts

Republic Aviation Corporation
Farmingdale, Long Island, New York

Space Technology Laboratories
Los Angeles, California

Sperry Rand Corporation
Sperry Gyroscope Corporation
Great Neck, New York

Sylvania Corporation
Electronics Systems Division
Waltham, Massachusetts

Technical Information Systems and Services, Inc.
Atlanta, Georgia

Thiokol Chemical Corporation
Brigham City, Utah

Thompson-Ramo-Wooldridge, Inc.
Tapco Group
Cleveland, Ohio

Todd Shipyard Corporation
San Pedro, California

Western Electric
Winston-Salem, North Carolina

Westinghouse Electric Corporation
Sharon, Pennsylvania

Government

Office of the Secretary of Defense

OASD (I&L)
Washington, D. C.

Army

Headquarters, Army Materiel Command
Washington, D. C.

Missile Command
Huntsville, Alabama

Weapons Command
Rock Island, Illinois

Navy

Bureau of Ships
Washington, D. C.

Bureau of Weapons
Washington, D. C.

Naval Ordnance Test Site
China Lake, California

Office of Naval Material
Washington, D. C.

Special Devices Center
Port Washington, New York

Air Force

Aeronautical Systems Division (AFSC)
Wright-Patterson Air Force Base
Dayton, Ohio

Air Force Logistics Command
Wright-Patterson Air Force Base
Dayton, Ohio

Air Force Systems Command
Andrews Air Force Base
Washington, D. C.

Air Force (Cont.)

Ballistic Systems Division (AFSC)
Norton Air Force Base
San Bernardino, California

Headquarters, United States Air Force
Washington, D. C.

Defense Supply Agency

Defense Electronics Supply Center
Dayton, Ohio

Defense General Supply Center
Richmond, Virginia

Headquarters, Defense Supply Agency
Washington, D. C.

THE BOEING COMPANY Manual

CORPORATE POLICY

DATE: August 20, 1962

NUMBER: 4H1

SUBJECT: VALUE ENGINEERING

COMPLIANCE REQUIRED BY: ALL COMPANY ORGANIZATIONS

It is The Boeing Company policy to use Value Engineering as a method of controlling the total cost of Boeing products. Essential quality, functions, schedules, reliability, maintainability and operational performance shall not be compromised. Value Engineering shall be applied to design concepts, specifications, engineering, procurement, manufacture, test and operations.

Value Engineering is a systematic appraisal which relates cost to function and which considers all aspects of the product or system development from the conceptual stage through operational use and support for its specified life. The purpose of Value Engineering is to identify high cost areas for the timely elimination of unnecessary cost. Other product cost reduction and product improvement activities shall be consonant with the Value Engineering program.

The Boeing Company will work with customers, associate contractors, subcontractors, industry and government in developing and maintaining a practical application of Value Engineering with a minimum of administrative cost.

RESPONSIBILITIES

Each Division Manager is responsible for compliance with this policy.

The Senior Vice President will monitor the Value Engineering efforts of the Company, initiate action to keep this policy up to date and provide for interpretation and interdivisional coordination as necessary. He will issue and maintain as a supplement to this policy a Value Engineering Program Guide which will reflect the agreement of the Division Managers with respect to general management and technical considerations applicable to the development and implementation of an effective Value Engineering Program.

William M. Allen

William M. Allen

HUGHES

NO. 6-2

Company Policy

DATE 7-27-62

SUBJECT Product Effectiveness (Quality, Reliability, Maintainability and Value Engineering)

Supersedes CP 6-6 dated 9-23-60
CP 7-3 dated 8- 7-61

The company's reputation for the effectiveness of its products is a major asset. It is the policy of the company, through continuous improvement in appropriate practices, techniques, and applications, to assure that customers are provided with superior products at the lowest over-all cost consistent with meeting specified operational requirements for function, quality, reliability and maintainability.

1. The product effectiveness practices of the company are developed and basic programs are reviewed and coordinated at the corporate level by the Product Effectiveness Committee under the chairmanship of the Vice President - Engineering. This committee is composed of the directors of the product effectiveness programs of the operating groups and the director of corporate and contracting policy.

The group executives are responsible for developing and administering quality, reliability, maintainability and value engineering programs within their respective organizations in accordance with established company practices.

Roy E. Wendahl
Executive Vice President

Her. 715

HERCULES POWDER COMPANY

Wilmington, Delaware
August 6, 1962

C. A. BULLETIN #8

TO: DISTRIBUTION

FROM: W. E. HOWELL
CHEMICAL PROPULSION DIVISION

COST REDUCTION (VALUE ENGINEERING)

The purpose of this Bulletin is to explain the policy regarding Cost Reduction Programs, such as our Value Engineering Program, or others which may be instituted from time to time, and their application to the majority of our contracts, which are cost-plus-fixed fee.

Firstly, it is recognized that our Cost-Plus-Fixed Fee Contracts do not contain a specific incentive or reward provision for reductions in costs achieved through our Value Engineering Program or otherwise.

Secondly, it is correct to assume that where there is a decrease in the scope of work on which the fee is fixed, there will be a relative reduction in the fixed fee. Therefore, it has at times seemed somewhat paradoxical for a business enterprise to sponsor an active cost reduction program with the probability that the fee will be reduced in a relative proportion to its ability to reduce costs. A revision to the contracts to reverse this condition is being sought. This administrative weakness does not, of course, exist in Firm Fixed Price and the Incentive Type Contracts. Unfortunately, Air Force Procurement Circular No. 16 dated April 17, 1962, does not deal with CPFF contracts. LMSC is reviewing the possibility of employing an incentive condition for cost reductions under the Value Engineering Program.

Thirdly, it is important to note that there are cost reductions which do not alter the scope of work on which the fee is fixed and therefore there would not be an adjustment to the fee.

The intent of the foregoing paragraphs is to inform the various levels of management of the CPFF contract conditions that exist which in certain instances are not ideal for perpetuating cost reduction efforts. However, Hercules policy in effecting cost reductions transcends any contract condition which, at least super-

HERCULES POWDER COMPANY

ficially, may seem to work a disadvantage through possible reductions in fee. All personnel are urged to regard all contracts as if they were Firm Fixed Price Contracts in which any reduction in costs would result in an equal increase in profit. The reasons for this are fundamental. We must be able to progressively demonstrate our ability to reduce costs in order to remain in a competitive status and be favored with continuing orders. We must prepare for incentive contracts, and Firm Fixed Price Contracts which undoubtedly offer the greatest incentive of all. We owe a duty to our customer and ourselves in performing both diligently and efficiently. These requisites are impossible without exerting an uncompromising effort to reduce costs.

Regardless of the nature of the cost reductions to be proposed or instituted, which are dependent upon the governing contract conditions, it is the responsibility of Contracts Administration to negotiate the best possible adjustments within the meaning of the contract at the time of the action. For example, an advantageous trade-off may be possible which might also alleviate administrative burdens. The contract must be searched in any event to determine whether or not the reduction in costs affects the scope of work. An approach to negotiations should be determined before the customer is advised and a proper presentation must be made. It is therefore considered imperative that all cost reduction proposals or actions be coordinated with and agreed to by Contracts Administration before being presented to Management and finally to the Customer.

Your implementation of this policy is requested.

Lowell

WEH:mlh

DEPARTMENT OF THE NAVY
OFFICE OF THE SECRETARY
WASHINGTON

SEC NAV 4858.1
SO-2
JUL 19 1960

SEC NAV INSTRUCTION 4858.1

From: Secretary of the Navy

To: Commandant of the Marine Corps
Chief of Naval Material
Chief, Bureau of Naval Weapons
Chief, Bureau of Ships
Chief, Bureau of Supplies and Accounts
Chief, Bureau of Yards and Docks
Chief of Naval Research

Subj: Value Engineering in the Navy

1. Purpose. This instruction re-emphasizes the need to stress Value Engineering, and assigns responsibilities for soing so.

2. Background.

a. Value Engineering has been practiced for a number of years in industry and in the Navy. Various bureaus and offices have instituted Value Engineering Programs, both at naval activities and in industry. These programs have demonstrated that, without sacrificing essential performance or functions, significant cost reductions can be realized by concentrated efforts to identify and eliminate any unnecessary costs.

b. The ever increasing costs to produce and support complex ships, aircraft, missiles, and other equipment in the required quantities necessitate increased efforts in value improvement of naval equipment if we are to take advantage of rapidly advancing technologies and maintain the forces necessary for accomplishment of our missions.

c. The significant results achieved to date in individual items for which Value Engineering has been used indicate that broader implementation of the Value Engineering approach could yield worth while gains.

3. Policy. It is the policy of the Department of the Navy to make full use of Value Engineering techniques in all material areas.

4. Responsibility.

a. The Chief of Naval Material is responsible for developing and coordinating for the field of Value Engineering Navy-wide procedures and methods requiring uniform or centralized control, such as training programs, reporting of results, interchange of information, and contractual incentive arrangements.

b. Chiefs of Material Bureaus and Offices are responsible for implementing Value Engineering Programs in their organizations, including naval and industrial activities.

5. Action. Each addressee will develop plans, policies, and implementing instructions for formal establishment of Value Engineering Programs.

C. P. Milne
Assistant Secretary of the Navy
(Material)

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DEPARTMENT OF THE NAVY
BUREAU OF NAVAL WEAPONS
WASHINGTON 25, D.C.

IN REPLY REFER TO
BUWEPS 4858.1
RREN-2
23 May 1961

BUWEPS INSTRUCTION 4858.1

From: Chief, Bureau of Naval Weapons
To: Distribution List

Subj: Value engineering in the Research, Development, Test and Evaluation Program

1. Purpose. This Instruction establishes the policy and assigns the responsibilities for the accomplishment of value engineering in the Research, Development, Test and Evaluation Program.

2. Scope. This Instruction applies to the various programs, projects, and tasks funded within the RDT&E appropriations. (This does not include DT&E under PAMN appropriation).

3. Discussion. Value engineering, by commonly accepted definition, is an organized method for reducing the cost of a product without adversely affecting performance, reliability, and other required characteristics. The objective of value engineering, therefore, is to guide initial design and development to meet the advanced performance, reliability and maintenance requirements of the fleet at the lowest over-all cost. The salient characteristics of the value engineering method is that functions are examined rather than parts. Value engineering furnishes cognizant project officers and project engineers with an additional management tool for analyzing the cost of products under development. This is recognized as an integral part of good engineering but it is a phase which has often been neglected or delayed until only minor cost reductions are possible. For maximum benefit the value engineering method should be applied during feasibility studies involving hardware and at the beginning of development projects.

4. Policy. The Chief of the Bureau of Naval Weapons recognizes the need for and hereby establishes the policy for a more comprehensive value engineering effort in the RDT&E program. This method of reducing costs should be applied selectively in order to gain the necessary experience to eventually make it an integral part of the management of the Bureau's RDT&E programs. It is the policy of the Bureau to encourage the initiation of value engineering during applied research, feasibility study and early development phases of projects involving hardware.

5. Responsibilities. Division Directors of the Research, Development, Test and Evaluation Group of the Bureau of Naval Weapons and Commanding Officers of laboratories and activities having mission responsibilities

for research and development and/or engineering related to research and development shall be responsible for determining the extent and the performance of value engineering.

6. Action

a. Division Directors of the Bureau's RDT&E Group shall:

(1) Provide the necessary management support

(2) Arrange for necessary training of personnel

(3) Encourage contractors to provide value engineering training for their personnel.

(4) Arrange for formal value engineering requirements in selected programs, projects, tasks, contracts, etc.

(5) Encourage contractors to submit suggestions and recommendations on possible changes in performance, specifications, equipment configurations, and other requirements which would result in cost improvements.

(6) Arrange for the reporting of value engineering results.

b. Commanding Officers shall:

(1) Provide the necessary management support

(2) Arrange for necessary training of personnel

(3) Perform value engineering in selected programs, projects and tasks, for both in-house and contracted projects.

(4) Include value engineering requirements in appropriate research and development contracts and procurements.

(5) Encourage contractors and suppliers to submit suggestions and recommendations on possible changes in specifications and other requirements which would result in cost improvements.

(6) Document and report value engineering results of efforts performed in-house and contractually.

7. Training. The successful accomplishment of value engineering requires the proper understanding, motivation, and active participation of all levels of management and technical personnel in an organization. The Bureau's plans for Fiscal Year 1962 include three basic types of educational activity as follows:

BUREAU OF NAVAL WEAPONS

BUWEPSINST 4858.1
23 May 1961

TYPE	DURATIONS	AUDIENCE
Orientation presentations	1 to 4 hours	Top and upper mid-management
Indoctrination seminars	20 hours	Mid-management and technical personnel
Training courses	80 hours	Technical

The primary purposes of these educational activities for various types of audiences are to create a personal awareness of need, cost consciousness and job relationships to value engineering; to develop the proper attitudes, climate, and receptiveness toward value work;and to provide detailed training in the concepts and techniques of value engineering. This training program will be managed by the Bureau. Quotas will be assigned by a separate BUWEPS Notice, which will announce the training schedule for FY 62. This training will require a liberal policy in approving travel for attendance at seminars and courses on value engineering.

8. Funding. Funds for value engineering will be included in budgets for projects where this work is required. This will be arranged in ways which best meet the needs of the individual programs, projects, tasks or contracts, and the nature of the specific appropriation.

9. Reporting

a. There are two principal reasons for reporting the value engineering experience during research and development. These are:

(1) To exchange information between groups engaged in this type of work. Reports for this purpose should describe the functions to be performed and the design selected.

(2) To inform the Bureau of Naval Weapons regarding value engineering work being performed for planning and management purposes. Reports for this purpose should describe the process by which value engineering was performed and, where possible, give indications of the effectiveness of the results.

b. Reporting of accomplishments in value engineering can be included in customary progress reports, if desired, and thus avoid the cost of additional reporting. This integration of information will often be more advantageous than separate reports. Report Symbol BUWEPS 4858-1 is assigned to this reporting requirement.

F. L. ASHWORTH
Assistant Chief for Research,
Development, Test and Evaluation

ARMY REGULATIONS
No. 700-47

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., 8 March 1962

LOGISTICS (GENERAL)

VALUE ANALYSIS IN THE ARMY

(Reports Control Symbol LOG-342)

Section I. GENERAL

1. Purpose. These regulations set forth the policy of the Department of the Army with respect to value analysis as applied to Army materiel.

2. Objective. It is the objective of the Department of the Army, by means of value analysis, to obtain satisfactory materiel performance, required quality, and timely delivery at lowest cost.

3. Definitions. *a. Value analysis* is the broad term used to identify all actions which discern and eliminate unnecessary cost in the requirement, design, development, and procurement of Army materiel without sacrificing essential quality, reliability, maintainability, performance, or mission accomplishment. It is a functionally oriented, planned effort by trained personnel using specific techniques. It encompasses activities variously referred to as "value improvement" and value engineering.

b. Study is defined as an effort, review, analysis, project, task, or evaluation whose purpose is to ascertain whether the optimum relationship between a function and its cost has been effected. Once it has been determined that the cost is higher than considered necessary, the study will be expanded to include appropriate recommendations for obtaining the required optimum relationship.

c. Cost is the dollar equivalent of a process, a material, man-hours, or other economic resource.

d. Element is an organizational group.

e. Training is the education of individuals to enable them to qualify for and to become proficient in fulfilling their value analysis duties, assignments, and responsibilities. Training will be at various levels of effort.

4. General. The ever increasing cost to design, develop, produce, and support highly complex weapons and equipment make it necessary to intensify efforts to explore all means of obtaining satisfactory performance, necessary quality, improvement of production techniques, and timely delivery of materiel at lowest cost. A planned approach is needed to prevent the generation of unwarranted costs in new items without sacrificing quality or reliability. Of particular importance is the application of value analysis techniques in the initial materiel design stages to minimize the necessity for subsequent redesign. The design of standard type classified items must also be examined to discover and eliminate unnecessary costs in future procurement. This requires a sustained effort in the areas of design, development, and production. A vigorous value

*These regulations supersede AR 700-47, 21 September 1961.

analysis effort should include but not be limited to the following elements:

a. In process review of developmental items. See AR 705-5.

b. Product review (standard materiel).

c. Production process review (manufacturing).

d. Materials review (part of *a* and *b* above). See AR 754-10.

e. Procurement review (method of procurement make or buy, component breakout, scheduling).

f. Publicity (reach operating elements).

5. Procedures. The following guidance is offered on the procedures required to effectively promote value analysis activity:

a. Since value analysis applications permeate many different activities it is essential that effective value analysis liaison be established with users and within technical service activities responsible for design, planning, procurement, price analysis, product engineering, and manufacturing to locate those areas in the development, procurement, and production of materiel where value received may not be commensurate with cost.

b. It is likewise essential that effective liaison be established between contractors, using agencies, and the engineering and procurement personnel of military activities to demonstrate and emphasize by example the mutual benefits to be derived from the practice of value analysis by contractors in design, development, or supply contracts as appropriate.

c. "In house" performance of value analysis studies in areas where cost reduction appears feasible is an effective means in accomplishment of the value analysis objective. In this activity it is usually possible to maintain records of costs incurred as compared with the results achieved.

d. Establishment, where appropriate, of value analysis elements responsible for providing value analysis assistance to design, planning, procurement, and production activities is valuable in accomplishing the value analysis mission. Such organizational elements may act as the focal point in promoting the appropriate application of value analysis techniques both "in house" and with contractors.

e. The use of value engineering service contracts, the inclusion of value engineering coverage in engineering services contracts, or value engineering incentive clauses in accordance with ASPR 3-406.3 is encouraged as appropriate to supplement or augment "in house" activities on value analysis.

6. Training. It is essential that the personnel charged with the various facets of value analysis be properly trained through servicewide or local programs to insure that value analysis is effective.

7. Responsibilities. *a.* The Deputy Chief of Staff for Logistics and the Chief of Research and Development in their respective areas of interest (see AR 10-5) are responsible for supervision and coordination of Department of Army value analysis activities.

b. The chief of each technical service will—

(1) Formulate plans and procedures for the development of his value analysis effort.

(2) Designate a project officer as point of contact on value analysis matters.

(3) Program for training of key personnel as required to carry out his value analysis function.

(4) Keep the Deputy Chief of Staff for Logistics informed of the name of his Value Analysis project officer. (Exempt report par. 17*k*, AR 335-15.)

(5) Provide the Deputy Chief of Staff for Logistics, ATTN: LOG/E3, a value Analysis Schedule and Report (DA Form 2529-R) (RCS LOG-642), in duplicate, to show the progress on the status of the Value Analysis program. This program will be submitted on a quarterly basis and will be dispatched not later than the first day of the second month following the close of the reporting period (e.g., for the reporting period ending 30 June 1962, the report is to be completed and dispatched by 1 August 1962). The initial report to be submitted will cover the 3d quarter of fiscal year 1962. DA Form 2529-R (fig. 1) will be reproduced locally on 10½-inch by 8-inch paper. Instructions for preparation of report are in section II. The Surgeon General is exempt from this reporting requirement.

(6) Preclude establishment of detailed accounting procedures; and encourage, where appropriate, summarization of data and use of estimating techniques for reporting purposes.

(7) For uniform reporting purposes, establish the scope of the Value Analysis "studies" in the RDT&E areas on the same basis and synonymously with "tasks" as defined in paragraph 3*b*, AR 705-12.

(8) Forward two copies of his implementing instructions to the Deputy Chief of Staff for Logistics, ATTN: LOG/E3, within 60 days from the date of these regulations.

Section II. VALUE ANALYSIS SCHEDULE AND REPORT (RCS LOG-642)

8. Purpose. To provide direction, guidance, and instructions for the preparation and submission of DA Form 2529-R (Value Analysis Schedule and Report) to be used for program management purposes.

9. General. The report synthesizes data on the training, funds programed, workload, execution, results, and costs of Value Analysis (Engineering). By its use an overall program evaluation will be accomplished, and progress reported as appropriate.

10. Detailed instructions to complete report form. The form headings will be completed by inserting the technical service, completing and dispatching the report. The period ending (as of) date will be entered. The appropriate parenthetical entry of the report title (RDT&E) or (Logistical) will be checked. This action indicates that the contents of the report are confined to the appropriate Logistics or R&D program areas. Separate sheets will be provided in each area.

a. Lines 1 through 3. Report on the training of personnel in Value Analysis.

b. Line 1. Self-explanatory.

c. Line 2. Enter the total number of personnel scheduled for enrollment in Value Analysis training for the fiscal year (col. b) and for the quarter presently being reported (col. c); the projected training workload for each quarter will be indicated in columns d, e, and f.

d. Line 3. Enter the actual number of personnel that have completed the training for the fiscal year indicated in column b and the quarter being reported in column c. Attach as an inclosure, unless submitted with a previous Value Analysis Schedule and Report, the course outline.

e. Line 4. Reports on the projection of funds programmed for the implementation of Value Analysis. Enter the total funding for the fiscal year indicated in column (b), the funding for the quarter presently being reported in column c, and the projected funding by quarter in columns d, e, and f. Funds from such programs as 2210.800 Applications Engineering; 2340.1200 Maintenance Engineering Services; 4000.0000 Procurement and Production of Major Equipment; 4100.000 Procurement and Production of Ammunition and Missile Systems; 4230.1000 Production Engineering in advance of Schedule Procurement; 5000.0000-5900.0000 RDT&E, etc. are considered to be typical fund sources and will not be identified. If the source of funds is other than CRD/DCSLOG, provide information as to funding agency.

f. Lines 5 through 11. Forecast number of Value Analysis studies scheduled to be completed and report on workload forecast and execution. Include all items subject to Value Analysis irrespective of the source of funds.

g. Line 5. Self-explanatory.

h. Line 6. Self-explanatory.

i. Line 7. Enter the number of in-house studies forecast in the appropriate periods (cols. b, c, d, e, and f). Enter on the appropriate lines (7 and 8) the projected workload for each period listed.

j. Line 8. Enter the number of contractual studies forecast in the appropriate periods (cols. b, c, d, e, and f).

k. Line 9. Self-explanatory.

l. Line 10. Enter in columns b and c the number of in-house studies which have been completed.

m. Line 11. Enter in columns b and c the number of contractual studies which have been completed.

n. Line 12. Self-explanatory.

o. Line 13. Enter the number of in-house recommendations which have actually been adopted in the fiscal year in column b and the period presently being reported in column c.

p. Line 14. Enter the number of contractual recommendations which have actually been adopted in the fiscal year in column b and the quarter being reported in column c. In the event of an unsolicited recommendation from industry, enter data under remarks.

q. Lines 15 through 17. Report the dollar savings resulting from Value Analysis recommendations adopted.

r. Line 15. Self-explanatory.

s. Line 16. Enter the dollar value of savings derived from the entry in line 13 in columns b and c.

t. Line 17. Enter the dollar value of savings derived from the entry in line 14 in columns b and c.

u. Lines 18 through 20. Report the total costs incurred for the Value Analysis program. Inhouse costs will include salaries of personnel engaged in administration or performance of Value Analysis plus such other expenses (materials, travel direct, overhead, etc.) as required. Cost of personnel not fully engaged in the Value Analysis program will be pro-rated.

v. Line 18. Self-explanatory.

w. Line 19. Enter the cost incurred for in-house Value Analysis studies in columns b and c.

x. Line 20. Enter the cost incurred for contractual Value Analysis activities in columns b and c.

y. Line 21. Self-explanatory.

z. Remarks. Indicate herein any problem areas in the Value Analysis program; other explanatory entries concerning the report; any deviations from schedule/forecasts in excess of 10 percent, etc. All studies which result in a savings of $25,000 or more per study shall be tabulated. This tabulation list is to be made part of this report. Studies having a savings less than $25,000 per study shall be totaled; and the total will appear as a single line entry in the above list.

aa. Authentication and Signature. Self-explanatory.

TAOO 5035A

VALUE ANALYSIS SCHEDULE & REPORT (AR 700-47)	RDT & E / LOGISTICS	REPORTS CONTROL SYMBOL LOG-642 / PERIOD ENDING
TO:	FROM: (Technical Service Preparing)	

LINE NO.	LINE ITEMS	FY ___ CUMULATIVE	CURRENT		PROJECTED					
			FY	QTR	FY	QTR	FY	QTR	FY	QTR
	a	b	c		d		e		f	
1	Training in Value Analysis (2 + 3)				X X X	X X	X X X	X X	X X X	X X
2	No. Scheduled for Training									
3	No. Completing Scheduled Training				X X X	X X	X X X	X X	X X X	X X
4	Funds Programmed for Value Analysis									
5	Workload-Forecast and Execution (6 + 9)				X X X	X X	X X X	X X	X X X	X X
6	Forecast of No. of Value Analysis Studies Scheduled (7 + 8)									
7	In-House									
8	Contractual									
9	No. of Value Analysis Studies Completed (10 + 11)				X X X	X X	X X X	X X	X X X	X X
10	In-House				X X X	X X	X X X	X X	X X X	X X
11	Contractual				X X X	X X	X X X	X X	X X X	X X
12	No. of Value Analysis Recommendations Adopted (13 + 14)				X X X	X X	X X X	X X	X X X	X X
13	In-House				X X X	X X	X X X	X X	X X X	X X
14	Contractual				X X X	X X	X X X	X X	X X X	X X
15	Dollar Savings for Line 12 (16 + 17)				X X X	X X	X X X	X X	X X X	X X
16	In-House				X X X	X X	X X X	X X	X X X	X X
17	Contractual				X X X	X X	X X X	X X	X X X	X X
18	Costs incurred for Value Analysis (Cumulative) (19 + 20)				X X X	X X	X X X	X X	X X X	X X
19	In-House				X X X	X X	X X X	X X	X X X	X X
20	Contractual				X X X	X X	X X X	X X	X X X	X X
21	NET SAVINGS (15 Minus 18)				X X X	X X	X X X	X X	X X X	X X

REMARKS (Continue on Reverse if Necessary)

TYPED NAME, GRADE AND TITLE OF AUTHENTICATING OFFICER	SIGNATURE

DA FORM 2529-R, 1 Mar 62

Figure 1

[AG 400 (15 Feb 62) LOG/ES]

By Order of the Secretary of the Army:

G. H. DECKER,
General, United States Army,
Chief of Staff.

Official:
J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army: To be distributed in accordance with DA Form 12-9 requirements for DA Regulations—Logistics, Responsibilities, Functions, and Procedures—General—C (CONUS).

NG: None.

USAR: None.

[illegible]

BSD EXHIBIT 62-21
15 March 1962

VALUE ENGINEERING PROGRAM

For

MINUTEMAN

15 March 1962

Headquarters
BALLISTIC SYSTEMS DIVISION
Air Force Systems Command
United States Air Force

BSD EXHIBIT 62-21
15 March 1962

VALUE ENGINEERING PROGRAM FOR MINUTEMAN

FOREWORD

The Ballistic Systems Division recognizes that various cost reduction programs currently exist in most contractor establishments. What is often lacking, however, is a focal point for this effort. The purpose of BSD Exhibit 62-21 is to acquire this much needed point of emphasis on the Minuteman Program.

Additionally, the intent of this exhibit is to outline a number of specific tasks directed toward value assurance and value improvement in the process of weapon system acquisition. In turn, these tasks will provide a criterion against which contractor performance can be monitored and measured.

Samuel C. Phillips

Samuel C. Phillips
Brig. General, USAF
Minuteman Systems Program
Director (BSQ)

BSD EXHIBIT 62-21
15 March 1962

VALUE ENGINEERING PROGRAM

1.0 PURPOSE.

1.1 The purpose of this exhibit is to provide a focal point for vigorous and systematic effort to cost control acquisition of the Minuteman Weapon System.

2.0 SCOPE.

2.1 This document will apply, on a phase-in basis, to all Minuteman Associate Contractors. It is intended that existing contracts be amended to include all or part of the provisions of this exhibit as deemed appropriate by the cognizant contracting officer.

3.0 APPLICABLE DOCUMENTS.

3.1 ANA Bulletin 391a - "CHANGES: ENGINEERING, TO AIRCRAFT ENGINES, PROPELLERS, EQUIPMENT IN PRODUCTION AND SERVICE"

4.0 PROGRAM ORGANIZATION.

4.1 The contractor shall identify an organization responsible for the overall direction of value engineering efforts and shall clearly define its relationship to such other activities as engineering, manufacturing, finance and materiel.

5.0 VALUE ENGINEERING PHILOSOPHY.

5.1 Attainment of cost effectiveness in complex weapon system acquisition demands the systematic application of well defined management and engineering disciplines. Recognizing that many factors contribute to the overall cost of a weapon system, a clear requirement exists for the continual and rigorous analysis of each element of the total dollar figure. Value engineering provides this cost discipline which can be introduced at the conceptual stage of a weapon system and continually applied throughout the design, development, manufacturing, test and field operation phases.

5.2 To be most effective, value engineering (cost consciousness) must become a way of life for every member of the weapon systems team. While recognizing the need for some full time value engineers (as in the case of reliability), this philosophy takes into account the fact that a relatively small number of such individuals can motivate large functional groups to regard cost consciousness as a prime responsibility. More specifically, value engineers must initiate trade studies, develop cost models, participate in specification and design reviews, thus continually equating price to performance in each phase of weapon system acquisition.

5.3 This document outlines the minimum requirements for an acceptable Value Engineering Program.

6.0 VALUE ENGINEERING PROGRAM TASKS.

6.1 The Value Engineering Program shall include but not be limited to the following TASKS:

Task 1. Functional Analysis of a Weapon System.

1.1 Value Engineering techniques shall be utilized in the functional analysis of the total system. The four basic elements to be considered are:

a. HARDWARE
b. FACILITIES
c. PERSONNEL
d. DATA

1.2 Weapon system performance requirements shall be evaluated and a comprehensive list of functions shall be developed to satisfy these requirements.

1.3 The output of the functional analysis should include proposals to reduce complexity, maintainability, and lower overall system costs without sacrificing technical requirements.

NOTE: It is intended that this Task effort shall be phased into the existing functional analysis program, and accordingly, will apply only to areas not previously subjected to functional analysis.

Task 2. Cost Analysis.

2.1 In attaining the objective of cost effectiveness it is important to provide the engineer with accurate and readily available cost information on each specific project. This in turn necessitates a close working relationship between cost analysis and engineers.

2.2 Cost Studies and Cost Models shall be generated early in the program to achieve the maximum economies prior to release of engineering drawings.

Task 3. Specification Analysis.

3.1 Recognizing that "over specification" is one of the major contributors to excessive costs in weapon systems, model and equipment specifications shall be reviewed and challenged from a cost effectiveness standpoint.

3.2 Specification change proposals intended to prevent or reduce costs shall be processed in accordance with established ECP procedures.

Task 4. Design Reviews.

4.1 Design reviews shall be cost sensitive to the degree that value will be established as a design criterion. This approach is intended to assure the optimum trade-off between function, reliability, maintainability manufacturability and overall costs.

4.2 Value engineering shall be represented (as a member) on every design review board.

Task 5. Production Review of Pre-release Drawings.

5.1 The manufacturing organization shall hold value oriented reviews of hardware designs, prior to release for production.

5.2 The value engineering organization shall be represented in these reviews.

Task 6. Value Engineering Task Forces.

6.1 Recognizing that preventive measures are seldom completely effective, it will be necessary to re-examine certain hardware items after production go ahead. Items which appear to represent poor value shall be selected for value engineering review and analysis.

6.2 This shall be regarded as a task effort with participation of engineering, manufacturing and purchasing and other activities as appropriate.

6.3 Value engineering techniques shall be systematically applied during such hardware reviews.

Task 7. Purchasing Program.

7.1 Strong emphasis on value analysis shall be manifest within the materiel organization.

7.2 The following activities shall be included as a part of the materiel organization:

7.2.1 Design and Hardware Reviews - Purchasing value analyst shall be included on design and hardware review panels.

7.2.2 Check Lists - Value check lists shall accompany Request For Quote (RFQ's) to subcontractors which will encourage subcontractors to challenge those elements of design and specification which can be modified or eliminated without degrading product value. (See Value Analysis Check List, Attachment "C")

7.2.3 Supplier Indoctrination - The contractor shall encourage, assist and monitor subcontractors in the area of value engineering.

7.2.4 Bills of Material Review - Advanced bills of material shall be reviewed by purchasing value analysts and recommendations shall be made for substitutions which will reduce procurement costs.

7.2.5 Make or Buy - Deliberations of the make or buy committees shall reflect the application of value analysis techniques as a basis for trade-off decisions.

Task 8. Training.

8.1 The contractor shall provide value engineering training for employees whose decisions affect the ultimate costs of the weapon systems. Inplant "work-shop" training is preferred, ultizing projects germane to the weapon system, and representative of all elements of the system.

Task 9. Change Proposals

9.1 Engineering Change Proposals (ECP) - Class I (As defined in ANA Bulletin 391a)

9.1.1 In keeping with the concept of cost effectiveness, all changes requiring an ECP shall be analyzed from a value engineering standpoint prior to submittal for Configuration Control Board (CCB) action. The contractor shall conduct trade studies (relative to each proposed configuration change) in a manner which wil insure consideration of cost consequences of each approach.

a. The ECP form should be marked with a "V" for value; e.g., VECP.

b. A form similar to Attachment "A" shall be attac to the ECP form paying particular attention to Item 4, (dealing with deviations from equipment specifications).

9.2 Non-ECP Type Proposals - Class II Change.

9.2.1 Whenever a saving in the total cost of the equipment is proposed in the performance of the contract, and such change does not require approval by the Minute man CCB, the contractor shall document such proposals in a manner consistent with his own internal practice. Such documentation shall be subject to re by BSD.

Task 10. Reports.

10.1 Control Room Activity.

10.1.1 Value engineering shall be established as a control room item for the purpose of measuring progress against planned objectives. The following activities shall be charted as they relate to value engineering:

a. Functional Analysis

b. Cost Model

c. Specification Reviews

d. Target Cost Program (Performance shall be reported against specific targets)

e. Materiel Program

f. Value Engineering Configuration and Control Actions. (Number of ECP's processed toward cost reduction and total dollar value)

g. Non-ECP type Cost Reduction Activity.

10.2 <u>Monthly Letter Reports.</u>

10.2.1 Monthly letter reports shall be submitted. These shall be brief, concise, and shall deal only with <u>departures</u> from program plan.

10.3 <u>Status Reports.</u>

10.3.1 Status reports shall be submitted quarterly as a part of existing requirement for technical progress reports. These reports shall detail the status of the program including the following:

a. Cumulative man-days expended

b. Change proposals submitted

c. Areas under active investigation for which change proposals are contemplated

d. Estimated cost reduction potential of these contemplated change proposals.

10.4 <u>Final Report.</u>

10.4.1 Upon completion of the value engineering program the contractor shall submit a final report to the agency indicated in the contract. This report shall be included in the final program report and shall contain the following information:

a. Number of hours and activity of all personnel participating directly in the value engineering program.

Summary of all value engineering change proposals made and the Air Force comments thereon.

c. Summary of all specification changes resulting from the accepted or approved value engineering change proposals.

d. A breakdown showing savings accrued:

(1) as a result of specification changes

(2) as a result of other contract changes

(3) as a result of changes made not involving contract or specification changes.

e. Summary of all instances where performance, reliability, or maintainability were improved as a result of the value engineering program.

f. Comments and suggestions concerning the value engineering change program and its administration.

10.4.2 The report shall be concise. Illustrations and tables shall be used where their use will contribute to clarity and brevity.

7.0 DEFINITIONS.

7.1 Value Engineering Program.

An organized, objective appraisal by value specialists of all elements of an equipment, system, organization or procedure; with the intent of establishing a minimum cost for that entity or activity's essential characteristics.

7.2 Value Specialist.

A person qualified to administer or conduct a value engineering study. He shall have had formal training or equivalent experience as a valuc engineer, and be capable of generating value engineering proposals which improve the value, or reduce the cost of equipment or procedures.

7.3 Value Engineering Proposals.

A formal document which clearly stipulates a procedure or equipment for which a change can be made. This change shall result in an overall cost improvement, whether directly or indirectly (as increased maintainability, reliability or lowered support costs), without loss of any essential characteristics.

7.3.1 VECP - Class I - A value engineering change proposal which must be approved by the Configuration Control Board (CCB).

7.3.2 Non-VECP - Class II - Value improvement proposals which do not require prior approval of CCB, and therefore are internal contractor documents.

7.4 Essential Characteristics.

The minimum operational, functional, maintenance and reliability needs of the user.

7.6 Task Force.

A team of value oriented specialists with a specified, short term objective; a problem or project for which the team must generate a value oriented report within a specified number of working weeks. The project may be a unit of subsystem hardware, or a procedure involving people, facilities and/or hardware.

BSD 62-21
15 March 1962

VALUE ENGINEERING PROGRAM MATRIX

	CORPORATE-DIVISION MANAGEMENT	PROJECT MANAGEMENT OFFICE	ENGINEERING	MANUFACTURING	MATERIEL	FINANCE	CONTRACTS	VALUE ENGINEERING	RELIABILITY AND QUALITY CONTROL	TRAINING AND EDUCATION	MATERIALS AND PROCESSES
1. Functional Analysis		ϕ	*					A			
2. Specification Reviews		ϕ	*				A	✓	A		A
3. Design Reviews		ϕ	*	✓	✓			✓	✓		✓
4. Production Drawing Reviews		ϕ	X	X				✓			✓
5. Hardware Analysis		ϕ		*				✓	A		✓
6. Software/Data Analysis	X	ϕ	X	X				✓			
7. Subcontractor V. E. Effort		ϕ			*		A	✓	A		
8. Internal V. E. Communications - Indoctrination		ϕ						*		✓	
9. Make or Buy		ϕ	X	X			A	A	A		✓
10. Target Costs		ϕ	X	X		X		✓			A
11. Mathematical Models		ϕ	*	A		✓		✓	✓		A
12. Cost Models		ϕ				*		✓			
13. Cost Improvement Program	X	ϕ	X	X	✓	X		X		A	
14. Value Engr. Change Proposals		ϕ	✓	✓	✓	✓	A	✓	A		A
15. V. E. Documentation and Reporting		ϕ	A	A	A	A	✓	*	A		A
16. Seminar "Workshop" Training	A	ϕ	✓	✓	✓	✓	✓	✓A	✓	*	✓

FIGURE 1.

* Prime Responsibility
✓ Active Participation
X Shared Responsibility
ϕ Monitoring Function
A Advisory Function

LORAL

VALUE ENGINEERING CHECK LIST

In order to insure that our competitive position in the industry is continuously maintained, Loral Electronics Corporation has developed a very active Value Engineering Program. Our goal is to obtain the required performance and reliability at the lowest possible cost. It is therefore requested that the following questionaire be carefully and completely answered as the questions apply to the items upon which you are furnishing quotations. You are encouraged to freely recommend new, untried, or revolutionary ideas. If space is insufficient to adequately detail any recommended change, additional sheets, drawings, sketches, etc., may be added to this check list.

Part Nomenclature____________ Part No.____________ RFQ No.__________

1. Do you have a standard item that might be adapted for this requirement that would reduce the cost? Yes______ No______

Explain:____

2. Do you recommend material substitutions that will reduce the cost? Yes____ No___

Explain:____

3. Is there any part of this item or assembly that can be produced by some other means in order to reduce costs? Yes______ No______

Explain:____

4. Do you recommend changes to finish requirements which might reduce costs? Yes______ No______

Explain:____

5. Does it appear that test or quality control requirements are too stringent or especially expensive to maintain? Yes______ No______

Explain:______

6. Do any tolerances appear to be unreasonable or especially expensive to maintain? Yes______ No______

Explain:______

7. Do you have further suggestions for cost reductions? Yes______ No______

Explain:______

8. Does your company have a formal Value Engineering Program? Yes___ No___

If not, do you think it is advisable: Yes___ No___

9. Would you like Loral assistance in setting up a program? Yes___ No___

Approval of the above recommendations will result in the following estimated cost reductions:

	Unit	Tooling	Testing	Cost of Incorporation
1.	$	$	$	$
2.	$	$	$	$
3.	$	$	$	$
4.	$	$	$	$
5.	$	$	$	$
6.	$	$	$	$
7.	$	$	$	$

Company______

Signature______

Title______

Thompson Ramo Wooldridge Inc.

TRW

VALUE ANALYSIS CHECK LIST

WE ARE VALUE ANALYZING ALL ITEMS USED IN THE MANUFACTURE OF OUR PRODUCTS IN AN EFFORT TO OBTAIN EQUAL PERFORMANCE AND RELIABILITY AT LOWER COST. IN ORDER TO ASSIST IN THAT ENDEAVOR, YOU ARE REQUESTED TO FRANKLY ANSWER THE FOLLOWING QUESTIONS, AS THEY APPLY TO THE FOLLOWING ITEM UPON WHICH YOU ARE QUOTING OR CURRENTLY MANUFACTURING.

PART NAME | PART NUMBER

I. HAVE YOU A STANDARD OR SHELF TYPE ITEM THAT MIGHT BE ADAPTED TO THIS PURPOSE, AT LOWER COST? YES [ ] NO [ ]

EXPLAIN

II. CAN YOU SUGGEST ANY DESIGN CHANGES THAT WILL LOWER THE COST OF THIS ITEM? YES [ ] NO [ ]

EXPLAIN

III. IS THERE ANY PART OF THIS ITEM OR ASSEMBLY THAT CAN BE PRODUCED AS A CASTING, FORGING, EXTRUSION, OR ?, IN ORDER TO REDUCE OTHER FABRICATION COSTS? YES [ ] NO [ ]

EXPLAIN

IV. CAN YOU SUGGEST ANY MATERIAL SUBSTITUTION THAT WILL LOWER THE COST? YES [ ] NO [ ]

EXPLAIN

V. ARE THERE ANY FINISH REQUIREMENTS THAT COULD BE ELIMINATED, OR CHANGED, TO REDUCE COSTS? EXAMPLES: MACHINING OR POLISHING UNNECESSARY SURFACES, PLATING, PAINTING, ETC. YES [ ] NO [ ]

EXPLAIN

VI. ARE THERE ANY TEST, QUALIFICATION, OR OTHER REQUIREMENTS THAT APPEAR UNNECESSARY, OR THAT COULD BE RELAXED? YES [ ] NO [ ]

EXPLAIN

FORM TS-92

	YES	NO
VII. WOULD A RELAXATION OF ANY TOLERANCES, RADII, ETC., RESULT IN LOWER MANUFACTURING COSTS?	☐	☐
EXPLAIN		
VIII. IS THERE ANY WAY IN WHICH WE CAN ASSIST YOU TO FIND LOWER COST COMPONENTS FOR THIS UNIT?	☐	☐
EXPLAIN		
IX. HAVE YOU ANY OTHER SUGGESTIONS WHICH MIGHT SAVE WEIGHT, SIMPLIFY THE PART, OR REDUCE THE COST?	☐	☐
EXPLAIN		

WE ADVOCATE THE USE OF CREATIVE AND IMAGINATIVE THINKING IN APPROACHING ALL VALUE ANALYSIS PROBLEMS. FOR THIS REASON, WE ARE RECEPTIVE TO NEW, UNTRIED, OR EVEN REVOLUTIONARY IDEAS THAT MAY HELP TO PERFORM THE REQUIRED FUNCTION AT A LOWER COST AND WOULD, THEREFORE, WELCOME THE OPPORTUNITY OF DISCUSSING THEM WITH YOU. KINDLY SUBMIT SUCH IDEAS AS ALTERNATE PROPOSALS.

APPROVAL OF THE SUGGESTIONS CONTAINED HEREIN WILL REDUCE THE:

UNIT COST	TOOLING COST	QUALIFICATION COST
$	$	$

IN OUR OPINION THE SUGGESTIONS WE HAVE MADE WILL NOT ADVERSELY AFFECT THE FUNCTIONAL INTEGRITY OF THE ITEM.

COMPANY ____________________

SIGNATURE ____________________ DATE __________

TITLE ____________________

ITT KELLOGG VALUE ENGINEERING

ANALYSIS REPORT

REPORT NO.

CONTRACT DESIGNATION AND NO.	EQUIPMENT IDENTIFICATION	DATE

EQUIPMENT SPECIFICATIONS AND DRAWINGS INVOLVED

DESCRIPTION OF VE ANALYSIS

TYPE OF CHANGE RECOMMENDED: (CHECK THOSE APPLICABLE)

- ☐ MATERIAL
- ☐ STRUCT. DESIGN
- ☐ CONTROL DESIGN
- ☐ METHODS OR PROCEDURE
- ☐ MFG. PROCESS
- ☐ MECH. DESIGN
- ☐ TESTS
- ☐ APPLICATIONS
- ☐ SUBST. OF PARTS
- ☐ ELEC. DESIGN
- ☐ SPECIFICATIONS
- ☐ OTHER - IDENTIFY

IF PROPOSED CHANGE DEVIATES FROM EQUIPT. SPECS., DESCRIBE HOW, WHY, AND WHY CONFORMANCE IS NOT ESSENTIAL :

BENEFITS : (CHECK THOSE APPLICABLE)

- ☐ ELIMINATES PROPRIETARY ITEMS
- ☐ INCLUDES STANDARD PARTS
- ☐ SIMPLIFIES DESIGN
- ☐ REDUCES MAINTENANCE PARTS COSTS
- ☐ EXPEDITES PRODUCTION
- ☐ INCREASE FLEXIBILITY
- ☐ REDUCES USE OF CRITICAL MATERIAL
- ☐ ELIMINATES UNNECESSARY FUNCTIONS
- ☐ IMPROVES COMPATABILITY
- ☐ REDUCES MAINTENANCE LABOR
- ☐ REDUCES TRAINING NEEDS
- ☐ REDUCES OPERATIONAL COSTS

IS THE ACCEPTANCE OF THIS REPORT CONTINGENT ON THE ACCEPTANCE OF ANY OTHER VE REPORTS, IF SO, WHICH ONES ?

RESULTS IN CONTRACT COST :

UNIT - MATERIAL COST, WITH(OUT) BURDEN

ITEM	PRESENT	REVISED PER VE	COST REDUCTION
PURCHASED PARTS			
FABRICATED PARTS			
RAW MATERIAL			
TOOLING			
RENTAL			
TOTAL			

RESULTS IN CONTRACT COST : (CONT.)

UNIT - LABOR COST, WITH(OUT) BURDEN

ITEM	PRESENT/UNIT	REVISED PER VE	RATE	COST REDUCTION
ENGINEERING				
TOOLING				
MANUFACTURING				
INSPECTION				
INSTALLATION				
OTHER				
TOTAL				

UNIT - SUPPORT COSTS, WITH(OUT) BURDEN

ITEM	PRESENT/UNIT	REVISED PER VE	RATE	COST REDUCTION
INSTALLATION PARTS & MATERIAL				
INSTALLATION LABOR				
MAINTENANCE PARTS & MATERIAL				
MAINTENANCE LABOR				
OPERATOR LABOR				
TOTAL				

PRESENT UNIT COST	
TOTAL UNIT COST REDUCTION	
TOTAL CONTRACT COST REDUCTION	
PERCENTAGE OF COST REDUCTION	%

COMMENTS AND/OR SUMMARY:

VALUE ENGINEER	APPROVED

FORM 8473-2 (2/62)

VALUE ANALYSIS PROPOSAL

Originator to complete, retain one copy and send balance of copies to Value Analysis Manager

Part, Assembly or Supply No. | How Used (end product)

PRESENT | PROPOSED

(Attach supplementary drawings or other information when required)

Cost per 100 Units	Material	Labor	Burden*	Total Cost per 100	Annual Use (Units)	Annual Cost	Savings
Present ☐ Std. ☐ Est.							
Proposed							

*30% of labor plus 6.6% of material costs

Tooling Cost

Equipment Cost

Originators Signature ______ Date ______

Recorded by Value Analysis Manager and referred for further action and decision as designated below to

☐ Product Engineering ☐ Equipment Mfg. ☐ Supplies Mfg. ☐ Purchasing ☐ Sales ☐ Other

______ Date ______

☐ Acceptable proposal, effective target date ______

☐ Not acceptable proposal because ______

Signature ______ Date ______

FOR COST ACCOUNTING DEPARTMENT USE

☐ A. Proposals submitted ☐ B. Approved for implementation ☐ C. Implemented ☐ D. Rejected

FORM 60-171

PROPOSAL NO. ______________

VALUE ENGINEERING PROPOSAL

PRODUCT NO.	PRODUCT NAME	ITEM DESCRIPTION	ITEM OR PART NO.

	PRESENT CONTRACT	FORECAST
QTY AFFECTED		
NET SAVINGS		

QTY PER SYSTEM	TOTAL QTY REQD
CHANGE AUTHORIZATION	

PRESENT | PROPOSED

CHART IV

	MATERIAL	LABOR	TOT PIECE COST
PRESENT COST			
NEW COST			

STARTING COSTS			
DESIGN	METHODS	QUALIFICATION	TOTAL
ENGINEERING	TOOLING	PUBLICATIONS	

ANALYSIS COST

	PER SYSTEM	PRESENT CONTS
GROSS SAVINGS		

APPROVED BY
______________ (ENG.)
______________ (MFG. ENG.)
______________ (PURCH.)
______________ (Q.C.)

PREPARED BY ______________ DATE ______________

Product Line _ _ _ _ _ _ _ _
Proj. Name _ _ _ _ _ _ _ _ _ _ _ _ _
Proj. No.

VALUE ENGINEERING PROJECT STATUS

Design Engr. _ _ _ _ _ _ _
Prod. Engr.

Proposal No.	Section No.		Feasibility, Manpower, Funding Forecast Report		Delayed for Further Study		Redesign to Start	Evaluation to Start	Evaluation Completed	Customer Approval	Production Effectivity	E.C.O. Issued	Final Report			Cost Data			
																	Non-Recurring Cost	Net Savings per Unit	Ratio Savings/Cost
		S														Est.			
		P																	
		A														Imp.			
		S														Est.			
		P																	
		A														Imp.			
		S														Est.			
		P																	
		A														Imp.			
		S														Est.			
		P																	
		A														Imp.			
		S														Est.			
		P																	
		A														Imp.			
		S														Est.			
		P																	
		A														Imp.			
		S														Est.			
		P																	
		A														Imp.			
		S														Est.			
		P																	
		A														Imp.			

S - Schedule Date   P - Promise Date   A - Actual Date

ITT-COMMUNICATIONS SYSTEMS DEPARTMENT
VALUE ENGINEERING SEMINAR #3, AUGUST 6-10, 1962

Monday, August 6th

Session 1, 8:30 - 12:00

1. Opening Remarks
2. Introduction to Value Analysis
3. The organized Approach
   Speculative Thinking

Session 2, 1:00 - 5:00

1. Evaluate By Comparison
2. Evaluate Function
3. Blast & Refine

Tuesday, August 7th

Session 3, 8:30 - 12:00

1. 8:30 - Habits & Attitudes
2. 9:45 - Project Time
3. 11:30 - New Materials, Products & Processes
   Audio Visual Presentation

Session 4, 1:00 - 5:00

1. 1:00 - What Makes Excess Cost
2. Suppliers
3. Project Time
4. 4:30 - Road blocks

Wednesday, August 8th

Session 5, 8:30 - 12:00

1. Specifics - Not Generalities
2. Suppliers
3. 9:30 - Project Time
4. 11:30 - Don't Be a Hermit

Session 6, 1:00 - 5:00

1. 1:00 - Human Relations
2. Suppliers
3. Project Work
4. 4:45 - More Than Words

Thursday, August 9th

Session 7, 8:30 - 12:00

1. Use Your Judgment
2. Suppliers
3. Project Work
4. Value in Original Design

Session 8, 1:00 - 5:00

1. 1:00 - CSD Report
2. 1:45 - Project Work
3. Complete Projects
4. 5:00 - Close

Friday, August 10th

Session 9, 8:30 - 12:00

1. 8:30 - Set up Displays
2. 9:30 - Final Day Presentations

GENERAL MOTORS INSTITUTE

VALUE ANALYSIS

Program Outline

I. Introduction

1. Welcome to Institute
2. What is Value Analysis (General)
   a) Subject content (i.e., Principles and Techniques)
   b) Comparison to other "Cost Reduction" programs
3. History of the Development of Cost Analysis
   a) Initial work done by General Electric
   b) The Ford "Purchase Analysis" activity
   c) Value Analysis, Incorporated
   d) Promotional activities of N.A.P.A.
   e) Other Value Analysis programs
   f) Government interests in Value Analysis
4. The need for Value Analysis

II. Program Objectives

1. To present a method of evaluating products and services on the basis of "Functional Value."
2. To promote an understanding of the "Value Analysis" concept and to encourage "Value Consciousness."
3. To provide immediately usable techniques of cost reduction through "Value Analysis."
4. To emphasize the importance of lines of communication between cost authorities and functional authorities to successful "Value Analysis."
5. To provide supplementary knowledge in related fields which will facilitate the application of "Value Analysis."
6. To discuss various approaches in implementing a "Value Analysis" activity.

III. Definition of Terms & Discussion of Value Analysis Concept

1. Definition of Value Analysis (the Program).
2. Definition of Value Analysis (the Process).

3. Definition of "Value"

4. Definition of "Function"

5. The Value Analysis Concept

6. The Ten Tests for Value

IV. Areas of Application

1. Design Stage
(Includes Pre-Design, Design Concepts and Final Design)

2. Post Design
(Includes all stages after design)

3. Non-Product
(All remaining areas, other than above)

V. Introduction to the Value Analysis Job Plan and Techniques

1. Explanation of steps in the "Value Analysis Job Plan"

2. Integration of Techniques in the "Value Analysis Job Plan"

VI. Individual's Blocks to Problem Solving and New Ideas in Applied Value Analysis

1. Five Basic Steps in Problem Solving

2. Attitudinal Approaches to Problem Solving

3. Particular Attitudinal Handicaps to Problem Solving

4. Particular Faults in the Thinking Process

VII. Organization of Teams and Project Planning

1. Selection of Project

2. Formation of Teams

3. Discussion of Project Procedure

VIII. Product Design

1. Familiarization with Design Considerations

2. Making a Design Analysis

IX. Information Phase

1. Problem Orientation

2. Gathering Data

X. Analytical Phase

1. Making a Functional Analysis
2. Application of Analysis Techniques

XI. Project Work Related to Information and Analysis Phase

XII. Cost Analysis and Engineering Economy

1. Investigation of Manufacturing Costs
2. Methods for Comparing Alternatives
3. Analysis of Group Performance

XIII. The Role of Purchasing in Value Analysis

1. The Role of Purchasing in a Manufacturing Organization
2. The "Profit Making" Potential of Purchasing
3. The Buyer and Value Analysis
4. Value Analysis and Purchasing Skills
5. Questioning the Requisition
6. Challenging the Specifications
7. Using Vendor Specialists
8. Summary

XIV. Creative Phase

1. Various Techniques for Generating Ideas
2. Illustrative Problem
3. Creative Aspects of Value Analysis Work

XV. Investigation Phase

1. Aspects of the Problem which the Procurement Man Can Investigate
2. Review of Sources of Information

XVI. Project Work Related to Creative and Investigation Phase

XVII. Organization for Value Analysis

1. Five Approaches to Establishing a Value Analysis Activity in an Organization
2. Forms and Procedures Related to a Value Analysis Activity

XVIII. Organization Reaction to a Value Analysis Activity

1. A Value Analysis Activity Means More Work
2. A Value Analysis Activity can Become a Management Control or, a Reason for Extensive Investigations

XIX. Processes and Processing

1. Familiarization with Characteristics of Manufacturing Processes
2. Factors in Process Selection and Determination of Process Sequence

XX. Factors in Manufacturing Operations

1. Familiarization with Analysis of Labor and Other Manufacturing Costs
2. Material Utilization Considerations
3. Value Analysis Applied to Packaging

XXI. Evaluation Phase

1. Determination of Practicability of Proposed Ideas
2. Determination of Costs of Proposed Ideas

XXII. Project Work Related to Evaluation Phase

XXIII. Characteristics of Materials

1. Classification of Materials
2. Familiarization with Physical Properties of Materials

XXIV. Human Relations Factors in Gaining Acceptance for Value Analysis Activities

1. The Value Analyst's Approach and Attitude Toward Others

XXV. Recommendation Phase (Preparation of Reports)

1. Selection of Best of Several Alternatives
2. Determination of Order of Reporting
3. Preparation of Illustration or Demonstration Material

XXVI. Presentation of Project Reports

1. Problem Statement
2. Techniques Used
3. Results Achieved

BRIDGEPORT ENGINEERING INSTITUTE
VALUE ENGINEERING & ANALYSIS COURSE
FALL SESSION
1962

SESSION I - October 1, 1962

15 Min.	Introduction
45 Min.	History, Concepts, Philosophies and General Orientation of Value Engineering & Job Plan
10 Min.	Break
30 Min	General Techniques
30 Min.	Information Phase - Get All the Facts - Determine Costs
20 Min.	Project Work

SESSION II - October 8, 1962

30 Min.	Information Phase (Con't.). Define the Function.
30 Min.	Functional Workshop
10 Min.	Break
15 Min.	Case Histories
60 Min.	Project Work (Define Function)

SESSION III - October 15, 1962

15 Min.	Recognition of Roadblocks
15 Min.	Information Phase (Con't.) $ On Specs. and Requirements.
30 Min.	BuShips Film
10 Min.	Break
20 Min.	Functional Workshop
60 Min.	Project Work

SESSION IV - October 22, 1962

20 Min.	Creative Phase - Blast & Create
30 Min.	Creative Workshop
10 Min.	Break
15 Min.	How to Use the Supplier
75 Min.	Project Work (Start Creative Approach)

SESSION V - October 29, 1962

15 Min.	Quiz
40 Min.	Brainstorming Film (Republic, Bendix, G.E.)
10 Min.	Break
15 Min.	Case History
75 Min.	Project Work

SESSION VI	-	November 5, 1962
15 Min.		Every Idea Can Be Developed
30 Min.		Evaluation Phase - Refine Ideas - Put $ On Each Idea
30 Min.		Specialty Suppliers (2)
10 Min.		Break
65 Min.		Project Work (Refine Ideas - Use Specialty Supplier)
SESSION VII	-	November 12, 1962
		Dinner Meeting Specialty Suppliers (3) Film
SESSION VIII	-	November 19, 1962
30 Min.		Value Engineering - A New Tool To Be Used
45 Min.		Evaluation Phase (Con't.) Evaluate The Basic Function Evaluate By Comparison
10 Min.		Break
65 Min.		Project Work
SESSION IX	-	November 26, 1962
45 Min.		Purchasing Consideration in Selecting a Vendor
10 Min.		Break
90 Min.		Mid Term Exam.
SESSION X	-	December 3, 1962
15 Min.		Another Look at Creative Thinking
30 Min.		Investigation Phase - Consult Vendors - Use Company & Industry Specialists
30 Min.		Specialty Suppliers (2)
10 Min.		Break
65 Min.		Project Work
SESSION XI	-	December 10, 1962
20 Min.		The Importance of Evaluating Habits & Attitudes
40 Min.		Investigation Phase (Con't.) - Use Company & Industry Standards - Use Specialty Products, Processes & Materials
10 Min.		Break
70 Min.		Project Work

<u>SESSION XII</u> - December 17, 1962

60 Min.	Value Engineering & The Military
10 Min.	Break
30 Min.	"The Quest For Value" - G.E. - N.M.E.D. Film
50 Min.	Project Work

<u>SESSION XIII</u> - January 7, 1963

15 Min.	More Value in the Original Design
15 Min.	Mental Roadblocks to Progress
15 Min.	Manufacturing Process
30 Min.	What the Vendor Can Do For You
10 Min.	Break
65 Min.	Project Work

<u>SESSION XIV</u> - January 14, 1963

30 Min.	Recommendation Phase - Motivate Positive Action
30 Min.	Course Review
10 Min.	Break
15 Min.	Opportunities Are Everywhere
60 Min.	Project Work (Wrap It Up)

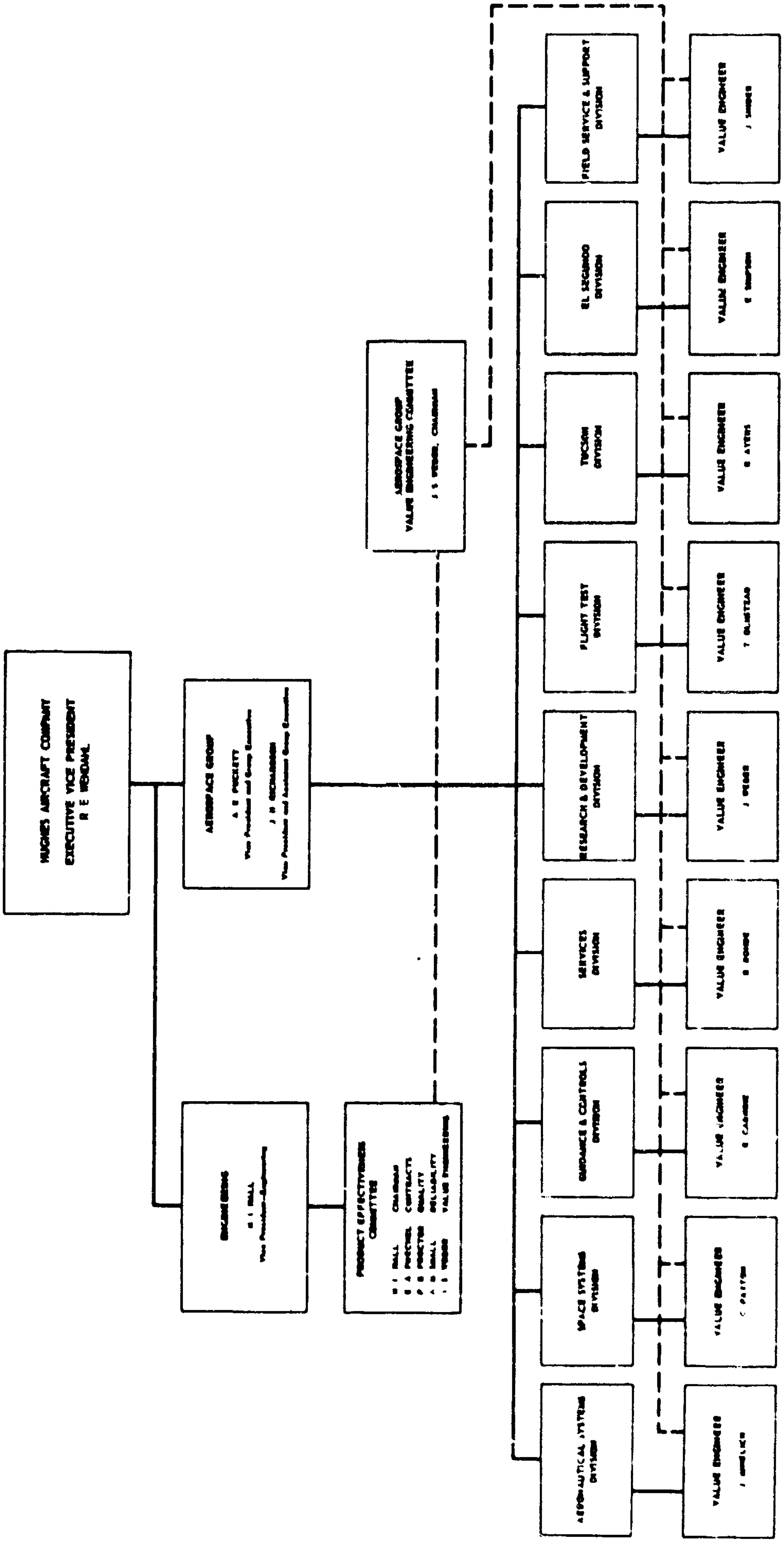
<u>SESSION XV</u> - January 21, 1963

Final Written Exam.
Presentation - Dry Run - 5-10 Min. each.

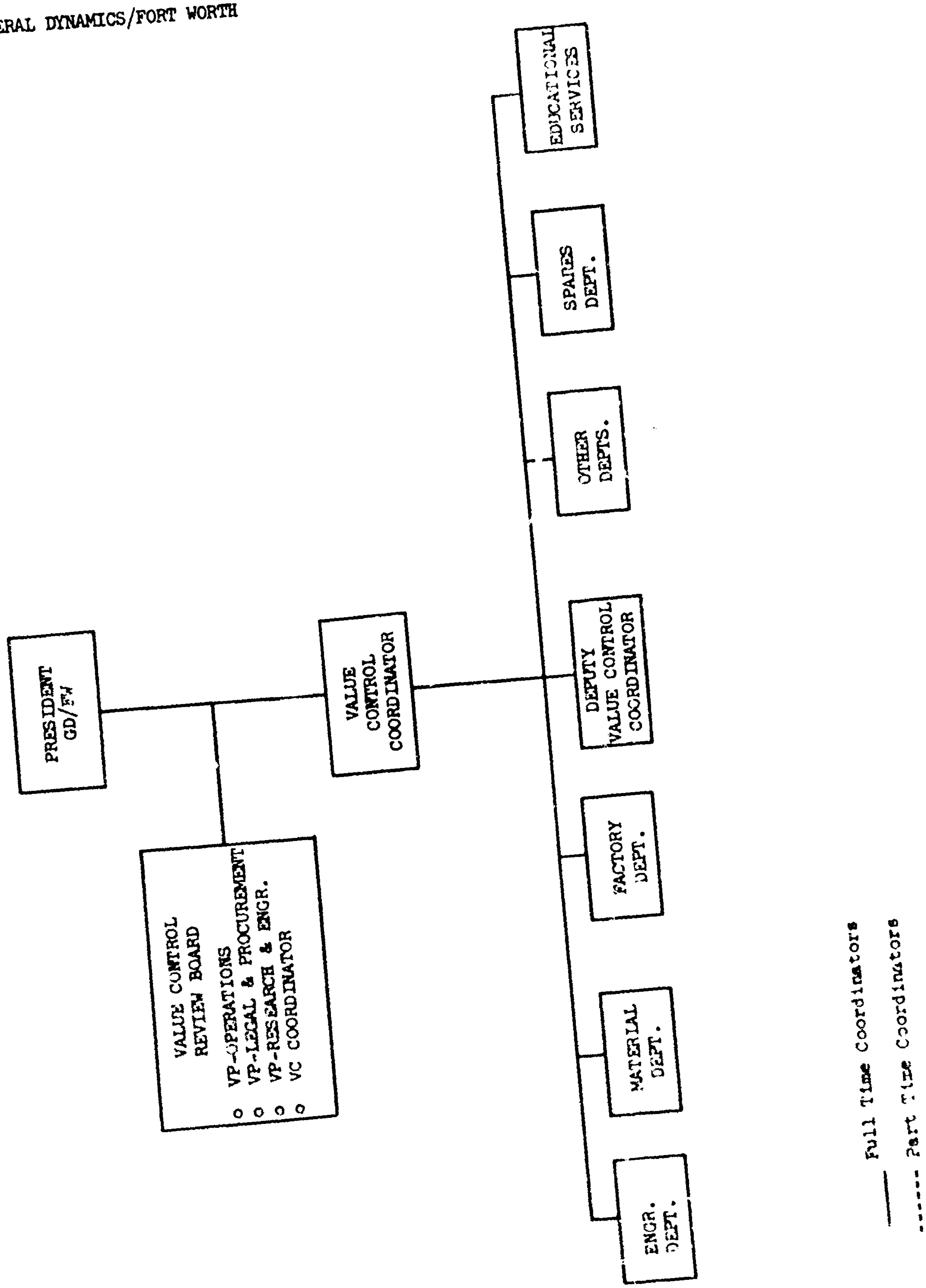
<u>SESSION XVI</u> - January 28, 1963

Dinner Meeting
Final Presentation of Project Recommendations

HUGHES AIRCRAFT COMPANY
AEROSPACE GROUP
VALUE ENGINEERING ORGANIZATION

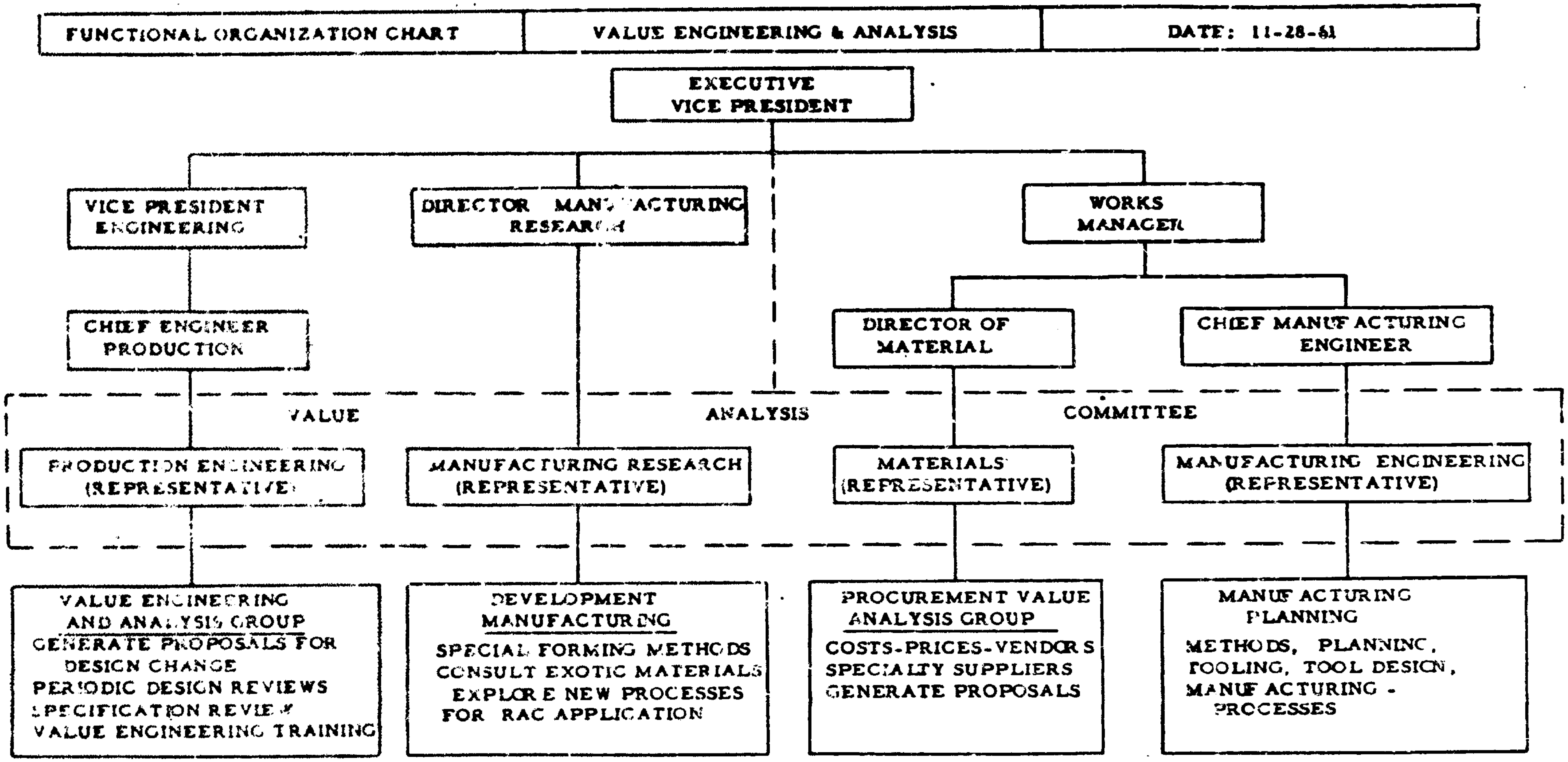


GENERAL DYNAMICS/FORT WORTH



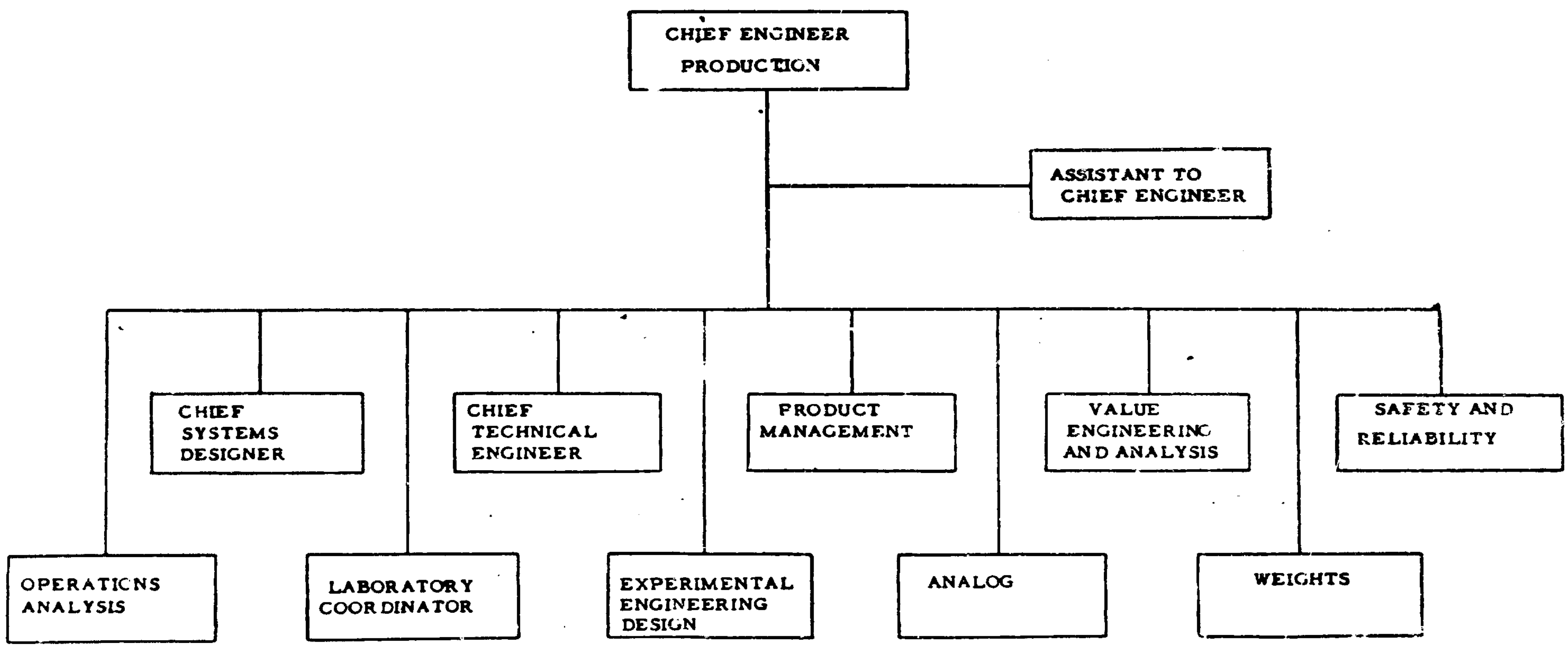
REPUBLIC AVIATION CORPORATION

FARMINGDALE, LONG ISLAND, NEW YORK

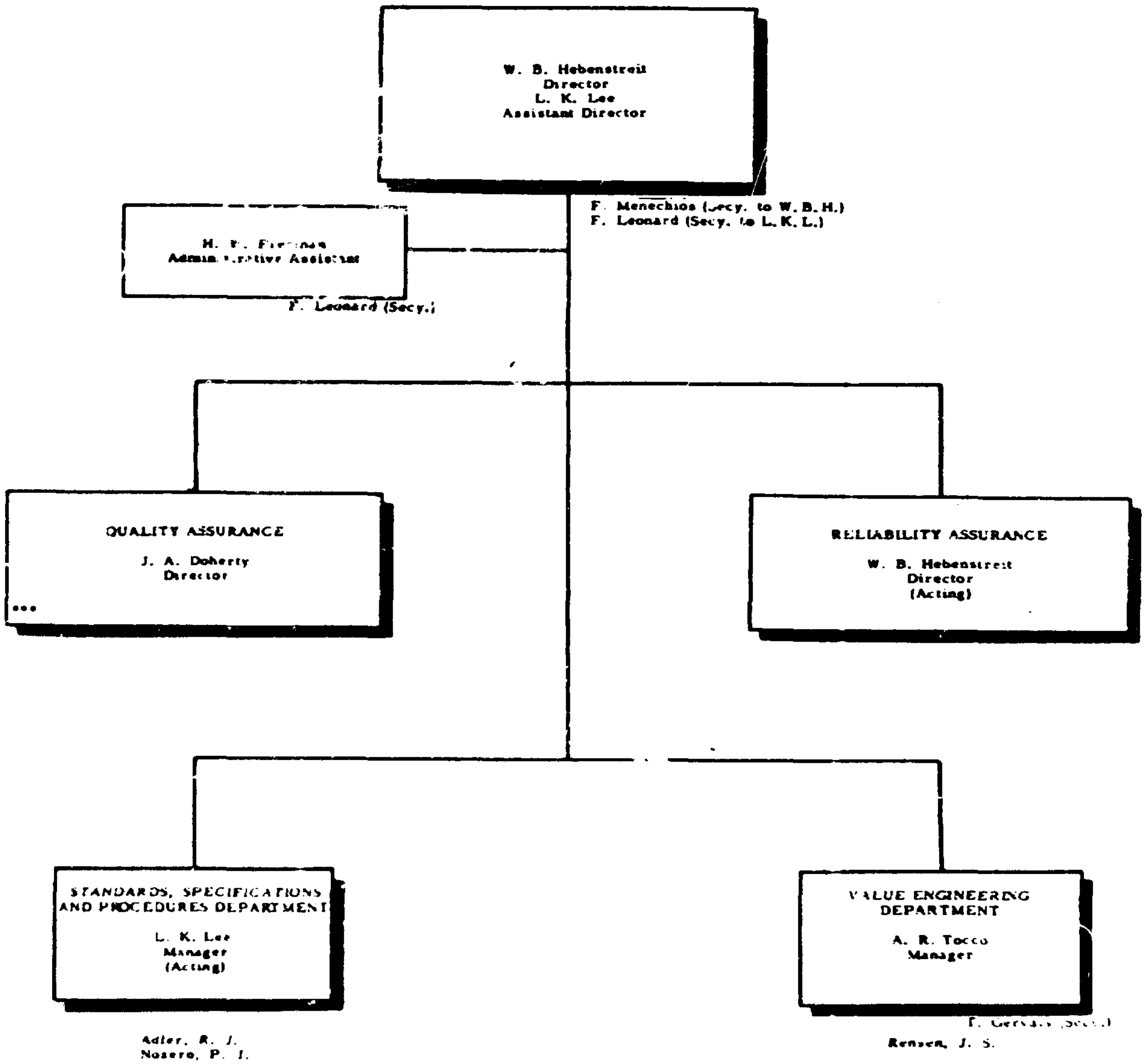


REPUBLIC AVIATION CORPORATION
FARMINGDALE, LONG ISLAND, NEW YORK

PRODUCTION ENGINEERING ORGANIZATION	FUNCTIONAL CHART	DATE: 11-28-61



SPACE TECHNOLOGY LABORATORIES, INC
PRODUCT ASSURANCE



*** Delineation of this organization appears on a following page.

LOCKHEED VALUE CONTROL

VALUE ENGINEERING ORGANIZATION

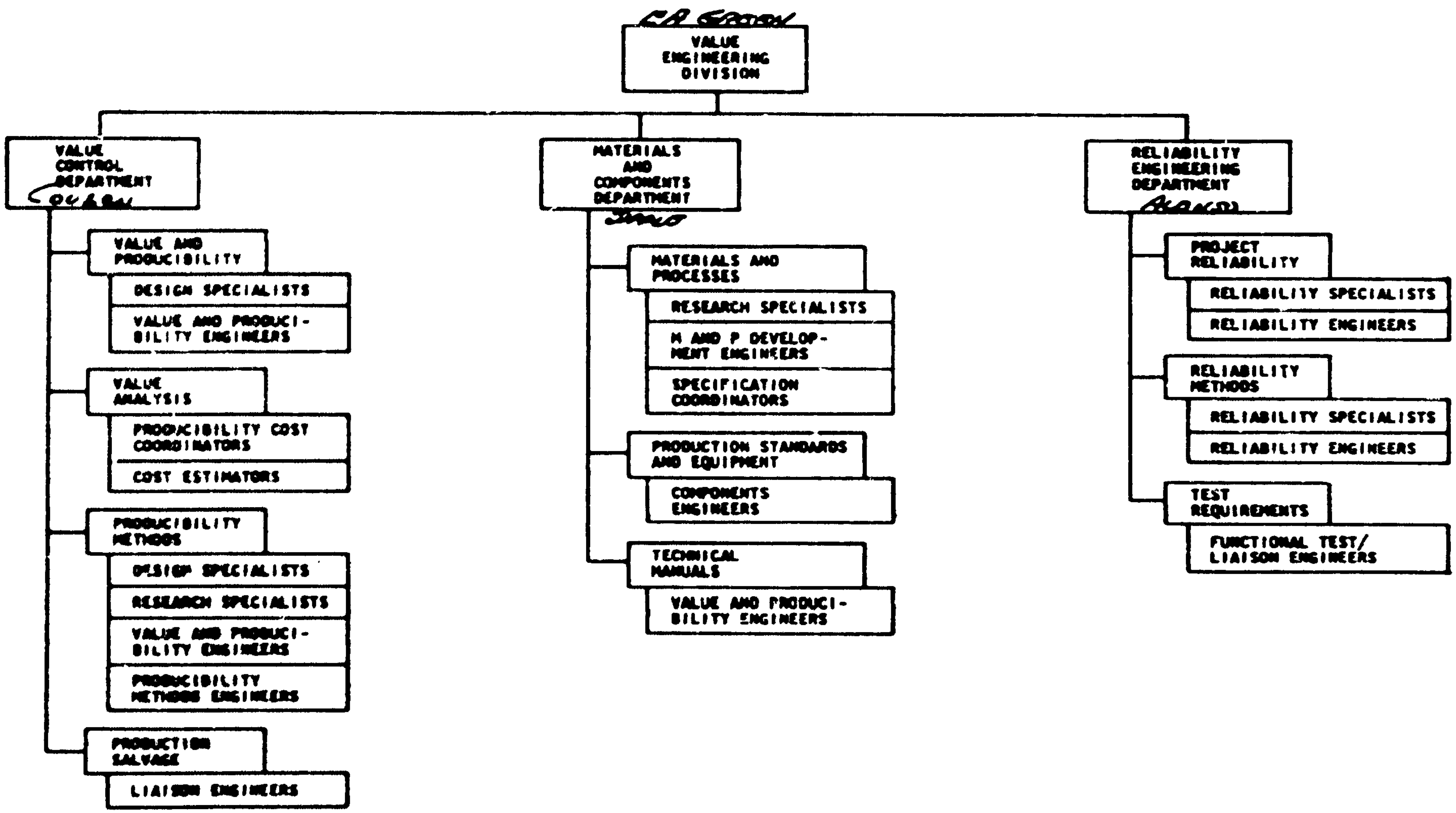


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EXHIBIT NO. 24

Distribution of Value Engineering Programs Among the 100 Top Defense Prime Contractors (FY 1961)

Rank as Defense Prime Contractor	Value Engineering Program Yes	Value Engineering Program No	Rank as Defense Prime Contractor	Value Engineering Program Yes	Value Engineering Program No	Rank as Defense Prime Contractor	Value Engineering Program Yes	Value Engineering Program No
1	X		34		X	67	X	
2	X		35		X	68	X	
3	X		36	X		69	X	
4	X		37		X	70		X
5	X		38	X		71		X
6	X		39		X	72		X
7	X		40	X		73		X
8		X	41		X	74		X
9	X		42		X	75		X
10	X		43		X	76		X
11	X		44	X		77		X
12	X		45	X		78		X
13	X		46		X	79		X
14	X		47	X		80		X
15	X		48		X	81		X
16	X		49		X	82		X
17	X		50		X	83		X
18		X	51		X	84		X
19	X		52		X	85		X
20	X		53	X		86		X
21	X		54		X	87		X
22	X		55	X		88		X
23	X		56	X		89		X
24	X		57		X	90		X
25	X		58		X	91		X
26		X	59		X	92		X
27	X		60		X	93		X
28	X		61	X		94		X
29		X	62		X	95	X	
30		X	63		X	96		X
31	X		64		X	97		X
32	X		65	X		98	X	
33	X		66	X		99	X	
						100	X	
Subtotal	28	5	Subtotal	12	21	Subtotal	7	27
						Total	47	53

Pentagon List of 100 Top Prime Contractors (FY 1961)[1]

FY 1961 Rank	Company	FY 1961 Rank	Company
1	General Dynamics Corp.	50	Textron, Inc.
2	North American Aviation, Inc.	51	International Harvester Co.
3	Lockheed Aircraft Corp.	52	Sanders Associates, Inc.
4	Boeing Co.	53	Goodyear Tire and Rubber Co.
5	General Electric Co.	54	Fuller (G.I.) and Webb (D.E.)
6	Martin Marietta Corp.	55	General Telephone and Electronics
7	United Aircraft Corp.		
8	American Telephone and Telegraph Corp.	56	Garrett Corp.
		57	Shell Caribbean Petroleum Co.
9	Sperry Rand Corp.	58	Socony Mobile Oil Co., Inc.
10	Radio Corp. of America	59	Olin Mathieson Chemical Corp.
11	Hughes Aircraft Co.	60	Lear, Inc.
12	International Business Machines Corp.	61	Ling-Temco Electronics, Inc.
		62	Morrison-Knudsen Co.
13	Westinghouse Electric Corp.	63	Johns Hopkins University
14	Douglas Aircraft Co.	64	Eby (Martin K.) Construction
15	Raytheon Co.	65	Ryan Aeronautical Co.
16	Republic Aviation	66	Ryan Aeronautical Co.
17	General Tire and Rubber Co.	67	Todd Shipyards Corp.
18	Newport News Ship	68	Kaman Aircraft Corp.
19	General Motors Corp.	69	Fairchild Stratos Corp.
20	Bendix Corp.	70	Eastman Kodak Co.
21	AVCO Corp.	71	Marine Transport Line, Inc.
22	Grumman	72	System Development Corp.
23	McDonnell Aircraft Corp.	73	Mason and Hanger--Silos Mason
24	Thiokol Chemical Corp.	74	Fluor Corp. Ltd.
25	International Telephone and Telegraph Corp.	75	Aerospace Corp.
		76	Richfield Oil Corp.
26	Standard Oil Co. (New Jersey)	77	Kewanee Oil Co.
27	Chrysler Corp.	78	Continental Oil Co.
28	Northrop Corp.	79	Magnavox Co.
29	Pan-American	80	Standard Kollsman Industries
30	American Machine and Foundary Co.	81	Standard Oil Co. (Indiana)
31	Philco Corp.	82	Fuller-Webb-Hardaman
32	Hercules Powder Co.	83	Northrop Pump Co.
33	Burroughs Corp.	84	Keystone Shipping Co.
34	Standard Oil Co. of California	85	Laboratory for Electronics
35	American Bosch Arma Corp.	86	Ingalls Iron Works Co.
36	Chance Vought Corp.	87	Hazeltine Corp.
37	Collins Radio Co.	88	Midland Constructors, Inc.
38	FMC	89	White Motor Co.
39	Texaco, Inc.	90	Vitro Corp. of America
40	Minneapolis-Honeywell	91	Firestone Tire and Rubber Co.
41	Massachusetts Institute of Technology	92	Jones-Teer-Winkelman
42	General Precision Equipment	93	Cook Electric Co.
43	Ford Motor Co.	94	Universal American Corp.
44	Bethlehem Steel Corp.	95	Westinghouse Air Brake Co.
45	Thompson Ramo Wooldridge, Inc.	96	Sinclair Oil Corp.
46	Bath Iron Works Corp.	97	ARO, Inc.
47	Curtiss-Wright Corp.	98	Marquardt Corp.
48	Hallicrafters, Inc.	99	Texas Instruments, Inc.
49	Continental Motors Corp.	100	Motorola, Inc.

[1] From Missiles and Rockets, "Pentagon List of Fiscal Year 1961, 100 Top Prime Contractors," 11 December 1961.

ENGINEERING CHANGE PROPOSAL QUESTIONNAIRE

1. State your current number of major production contracts (contracts on which Government approval of changes is required) of the following types:

CPFF	_____	Fixed Price	_____
Fixed-Price Incentive	_____	Other (Specify)	_____

2. Specify the number of major production contracts in the following production stages and the number of Class I Changes (changes requiring Government approval prior to implementation) processed to date:

Production Stage	No. of Contracts	E.C.P.'s Submitted To Date	E.C.P.'s Approved To Date	E.C.P.'s Disapproved To Date
In production less than six months	_____	_____	_____	_____
In production six months to one year	_____	_____	_____	_____
In production over one year	_____	_____	_____	_____

3. What has been your in-house change processing time of changes within the last three (3) years (from determination of need to submission to the Government for approval) for the following priority categories:

	Priority Category		
	Emergency*	Urgent*	Routine*
Shortest Time	_____	_____	_____
Longest Time	_____	_____	_____
Average Time	_____	_____	_____

---

* Emergency changes are those changes submitted to correct safety or deficiency conditions, the known uncorrected existence of

4. Do cost reduction or Value Engineering Change Proposals receive special or expedited attention based upon the magnitude of anticipated savings or the fact that they are of a cost reduction nature? Yes____________ No______________

5. Do you have a documented internal change procedure? Yes_____ No___________

6. Are time limits established in the change procedure for various actions or work areas? Yes_____________ No______________

7. Do the Engineering Change Proposals (or internal paper resulting in E.C.P.'s) flow to all action offices concurrently (in parallel) or is routing accomplished in sequential order (in series)? Parallel_______________ Series______________

8. Are there exceptions for particular types of changes? For example, must electrical groups review strictly mechanical changes or vice-versa; must ground equipment personnel review strictly airborne changes? Yes_____________ No___________
If yes, explain:

---

which could result in fatal or serious injury to personnel, extensive damage or destruction of equipment or high risk conditions.

Urgent changes are those submitted to correct potentially hazardous conditions, the known uncorrected existence of which could result in probable serious injury to personnel or damage to [illegible]pment and reduction of combat effectiveness. Such conditi[illegible] mpromise safety and embody risk within reasonable limits wherein affected equipment is continued in use with extreme caution.

Routine changes are those submitted to correct any other condition.

9. Are changes evaluated in scheduled meetings of personnel representing the affected company divisions/branches (Configuration Control Board)? Yes_______________ No_______________

10. If the Configuration Control Boards are utilized, is value engineering represented on at least an "as required" basis? Yes_______________ No_______________

11. What organizations within the company are required to review Engineering Change Proposals or internal change paperwork prior to submittal to the Government? Circle as appropriate:

    Engineering - Engineering Services - Planning - Value Engineering - Manufacturing Engineering - Estimating - Methods - QC - Reliability - Documentation - Purchasing - Contract Management - Sales - Other

12. What has been the Government reaction time to your Engineering Change Proposals submitted within the last three (3) years?

	Emergency	Urgent	Routine
Shortest Time	_____	_____	_____
Longest Time	_____	_____	_____
Average Time	_____	_____	_____

13. Do you document information relating to changes made on specific serialized items (Configuration Accounting)? Yes_______________ No_______________

14. What are your <u>specific</u> recommendations for shortening the time cycle from occurrence of failure, detection of system deficiency or detection of excessive cost/function relationship, until completion of all required corrective action?

FIRMS SUPPLYING DATA

Aerojet General Corporation

AiResearch Manufacturing Company

Autonetics Division, North American Aviation

The Bendix Corporation

The Boeing Company

Convair Astronautics, Division Dynamics Corporation

Douglas Aircraft Company, Inc.

Emerson Electric

General Dynamics/Pomona

GPL Division - General Precision, Inc.

Hoffman Electronics Corporation

Hughes Aircraft Company

Lockheed-California Company

Loral Electronics Corporation

Minneapolis Honeywell Corporation

Motorola Radio Corporation

Northrop Corporation, Norair Division

Raytheon Company

Republic Aviation Corporation

Radio Corporation of America

Rocketdyne Division, North American Aviation

Sperry Gyroscope Company

Thiokol Chemical Corporation

Todd Shipyard Corporation

Westinghouse Electric Corporation

CONTRACTOR PROCESSING TIME OF ENGINEERING CHANGES[1]

Time Breakdowns	Emergency Range[2]	Emergency Average All Contractors[3]	Urgent Range[2]	Urgent Average All Contractors[3]	Routine Range[2]	Routine Average All Contractors[3]
Shortest Time (Days)	1 - 7	3	1 - 21	14	1 - 45	16
Longest Time (Days)	1 - 90	20	3 - 270	61	10 - 360	145
Average Time (Days)	1 - 39	10	2 - 120	27	7 - 180	61

(Priority Category)

Notes:

1. Data derived from answers to Question 3 of ECP Questionnaire (Exhibit 2).
2. Indicates the smallest and largest figure reported out of all responses received
3. Non-weighted average of all responses in each time breakdown.

GOVERNMENT PROCESSING TIME OF ENGINEERING CHANGES[1]

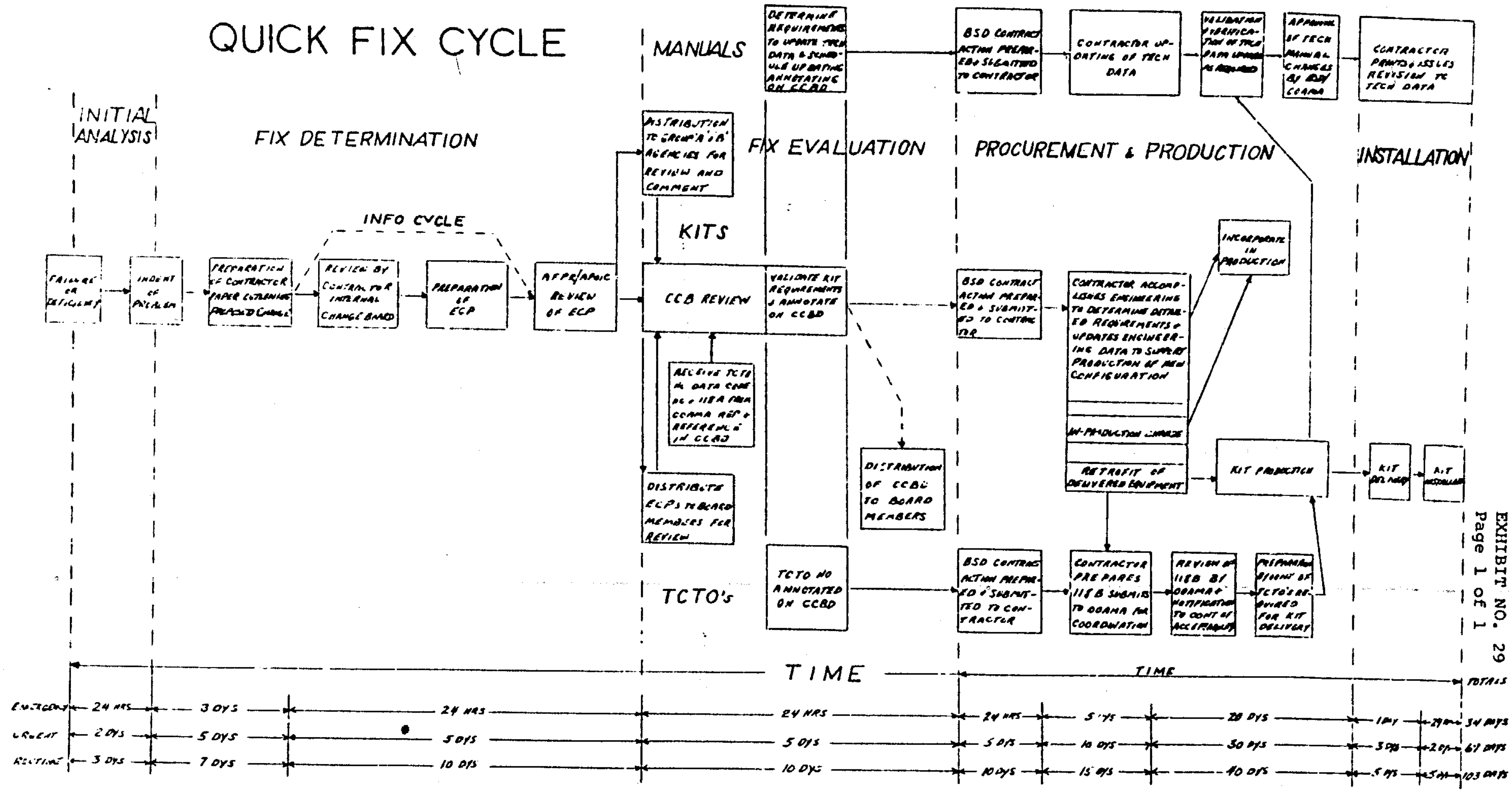
(As reported by contractors)

	Priority Category					
	Emergency		Urgent		Routine	
Time Breakdowns	Range[2]	Average All Contractors[3]	Range[2]	Average All Contractors[3]	Range[2]	Average All Contractors[3]
Shortest Time (Days)	1 - 42	7	1 - 184	38	1 - 120	33
Longest Time (Days)	1 - 180	33	15 - 540	124	15 - 720	216
Average Time (Days)	1 - 90	23	7 - 540	96	14 - 270	108

Notes:

1. Data derived from answers to Question 12 of ECP Questionnaire (Exhibit 1)
2. Indicates the smallest and largest figure reported out of all responses received.
3. Non-weighted average of all responses in each time breakdown.

QUICK FIX CYCLE



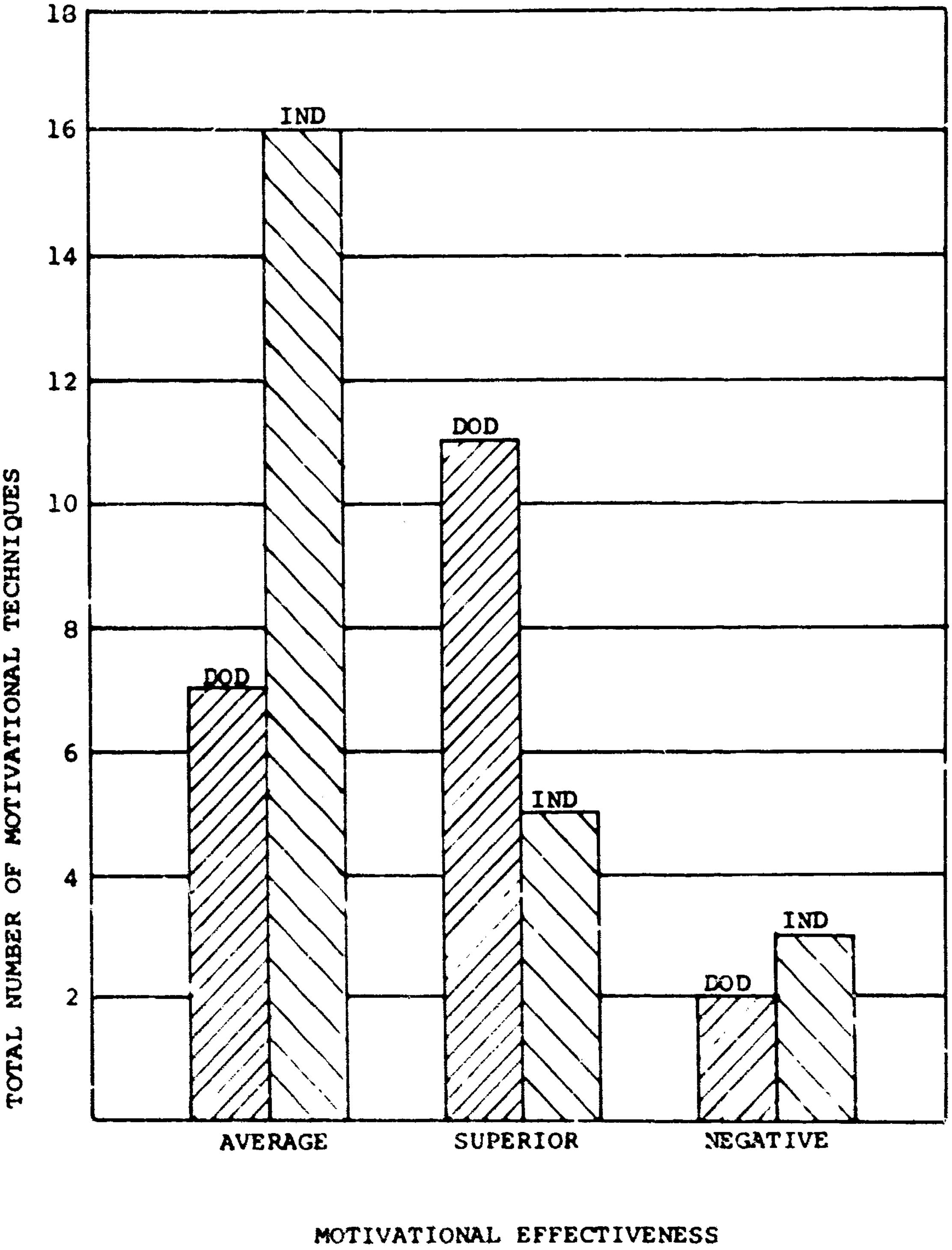
Analysis of Current Motivational Techniques for Value Engineering Practiced by DOD and Industry

MOTIVATION FOR VALUE ENGINEERING	PERFORMED BY		FREQUENCY			EFFECTIVENESS		
	DOD and Agencies	Indus-try	Rare	Moder-ate	Wide Spread	Aver-age	Supe-rior	Nega-tive
1. Cost Saving Sharing Incentive Clauses	x		x					
		None						
2. Renegotiation Policy	x			x				x
		Not Appl						
3. Directives	x		x				x	
		x		x		x		
4. MIL Specifications	x				x	x		
		Not Appl						
5. Designation of VE Personnel and Offices of Responsibility	x		x				x	
		x		x			x	
6. Awards for VE Accomplishments	x		x				x	
		x	x				x	
7. Individual Cost Performance in OER's, Merit Reviews	x		x				x	
		None						

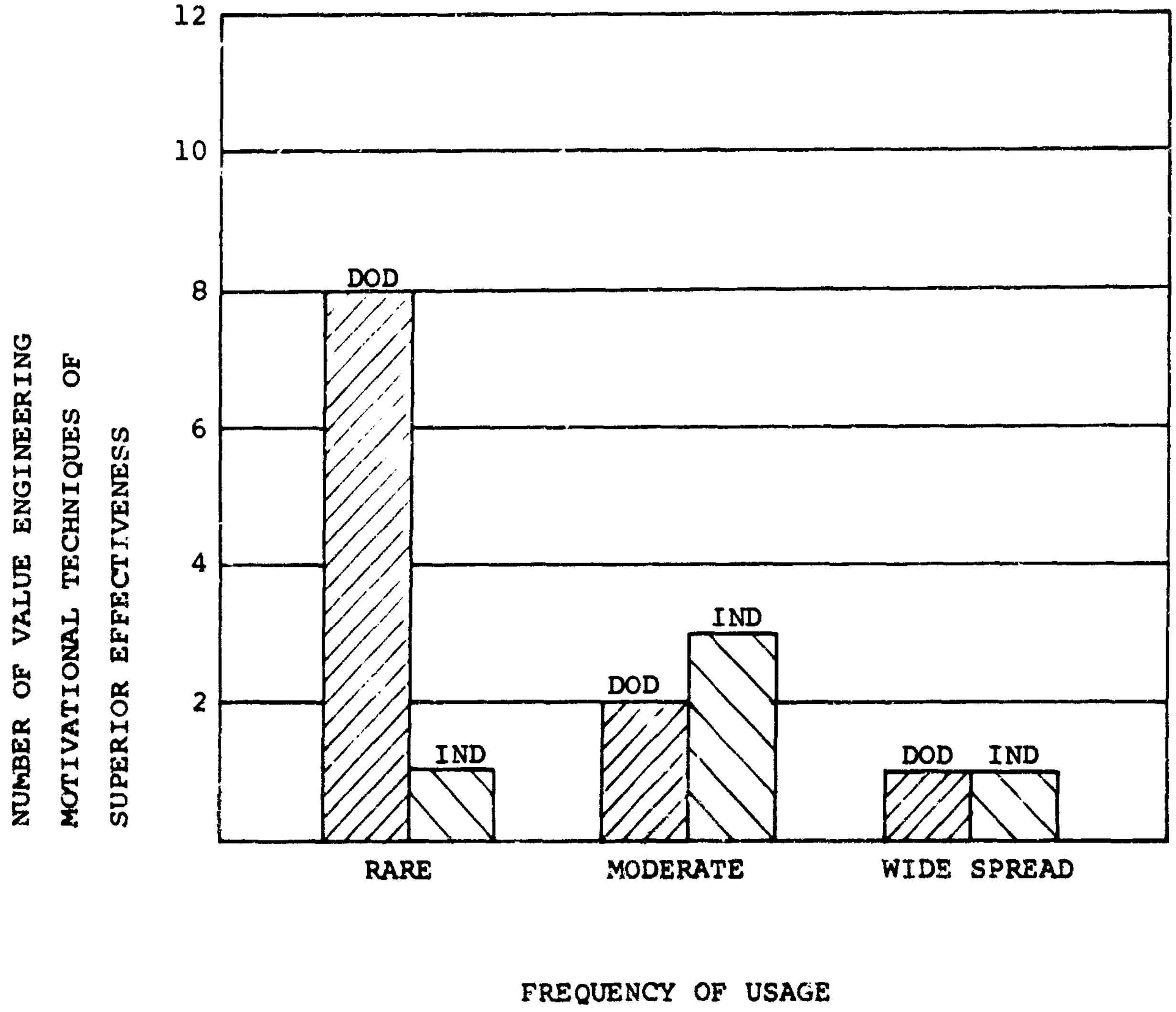
MOTIVATION FOR VALUE ENGINEERING	PERFORMED BY		FREQUENCY			EFFECTIVENESS		
	DOD and Agencies	Industry	Rare	Moderate	Wide Spread	Average	Superior	Negative
8. Public Statements of VE Support by Top Level Personnel	x			x			x	
		x	x			x		
9. Informal Personal Persuasion by Individuals	x		x				x	
		x			x	x		
10. Technical Papers and Articles on VE Topics	x			x		x		
		x			x	x		
11. Published Statements on Related Cost Effectiveness Attitudes	x			x		x		
		x	x			x		
12. VE Training Seminars	x			x		x		
		x			x	x		
13. Publicity of VE Examples of Cost Reductions	x		x			x		
		x			x	x		
14. Top Level Personnel Participation in VE Seminars	x		x				x	
		x		x			x	

MOTIVATION FOR VALUE ENGINEERING	PERFORMED BY		FREQUENCY			EFFECTIVENESS		
	DOD and Agencies	Industry	Rare	Moderate	Wide Spread	Average	Superior	Negative
15. Support of VE Society (S. A. V. E.) and Industry Assoc. VE Committees	x			x			x	
		x		x		x		
16. Institutional Advertising Citing VE	None							
		x	x			x		
17. Feature Articles in "House Organ" Newspapers	x		x			x		
		x			x	x		
18. VE Newsletters, Bulletins	None							
		x			x	x		
19. VE Posters, Signs	x		x			x		
		x	x			x		
20. Institutional Advertisements with VE Theme	None							
		x	x			x		
21. "Catch-phrase" Slogans, Cartoon Characters	x		x					x
		x	x					x

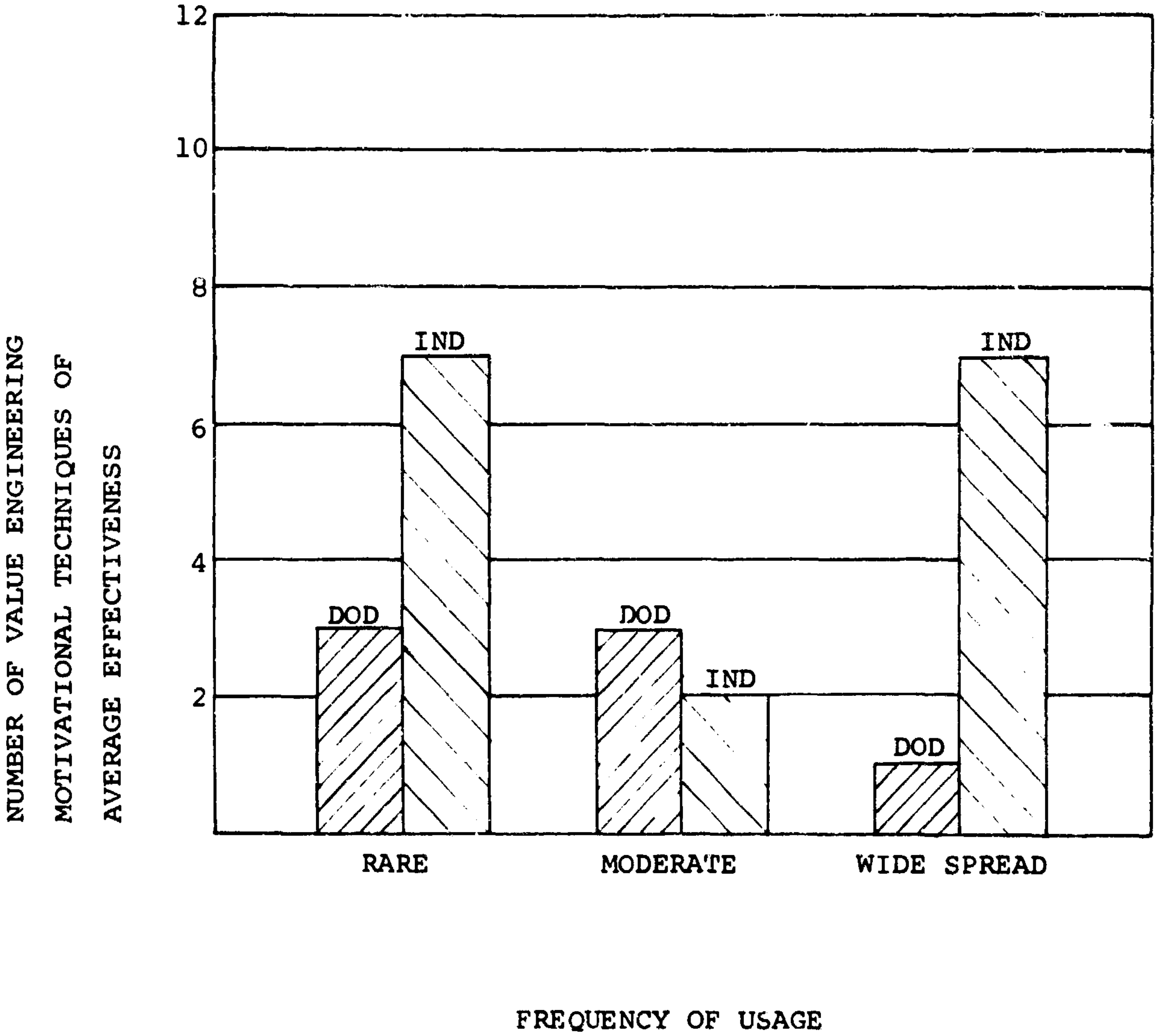
MOTIVATION FOR VALUE ENGINEERING	PERFORMED BY		FREQUENCY			EFFECTIVENESS		
	DOD and Agencies	Industry	Rare	Moderate	Wide Spread	Average	Superior	Negative
22. "Serious" Slogans	None							
		x	x			x		
23. VE Brochures	None							
		x			x	x		
24. Job Classification of Value Engineer	None							
		x	x					x
25. Price Squeeze Through VE	None							
		x		x				x
26. Supplier Participation in VE Seminars	x				x		x	
		x			x		x	
27. VE Indoctrination Programs for Suppliers	x		x				x	
		x		x			x	
28. VE "Check Lists" for Outside Purchased Parts	None							
		x	x			x		
TOTALS	20		12	6	2	7	11	2
		24	10	6	8	16	5	3



Distribution of the Motivational Techniques
for Value Engineering Currently in Use by
DOD and Industry



Frequency of Usage of the Superior Value
Engineering Motivational Techniques



Frequency of Usage of the Average Value
Engineering Motivational Techniques

RELATIVE EFFECTIVENESS* OF V.E. PROGRAMS
IN NAVAL SHIPYARDS, 1956-1961
(Descending Order)

(Norfolk used as base)

Pearl Harbor	3.73
Mare Island	2.26
Puget Sound	2.07
Boston	2.02
Long Beach	1.97
Philadelphia	1.89
Charleston	1.49
Portsmouth	1.48
New York	1.16
San Francisco	1.12
Norfolk	1.00

*Ratio of V.E. savings to total yard expenditures.

INCENTIVE GUIDE FOR VALUE ENGINEERING

Contract Type	Standard Sharing Formula on Savings from Implemented V.E. Proposals
CPFF[1]	Funded effort plus sharing of savings over 5 times the funded effort
CPIF[2]	50% - 50% of savings; **OR** CPFF funding formula--(contracts over $1 million)
FPI[3]	75% Contractor - 25% Gov't. of savings[5]
FFP[4]	75% - 25% of savings[5]
FP ESCALATION[4]	75% - 25% of savings[5,6]
FP REDETERMINABLE[4]	75% - 25% of savings[5,6]

Range of Funding for CPFF & CPIF V.E. Efforts

Contract Value - Annual -	Funding Limits - Annual -
$1-5 Million	$20-40 Thousand
5-10 "	40-80 "
10-50 "	80-120 "
50-100 "	120-180 "
over 100 "	200 "

[1] V.E. Program optional on contracts over $1 million; V.E. not to be used on contracts under $1 million.

[2] Inclusion of V.E. sharing clause mandatory on contracts over $100,000 unless funding approach is used in which case contracts must be $1 million or over.

[3] Inclusion of V.E. sharing clause mandatory on contracts over $100,000.

[4] Inclusion of V.E. sharing clause mandatory on contracts over $100,000; should not be used on contracts under $100,000 or contracts where prices are set by the competitive market.

[5] See discussion in text for sharing ratio on FP-type contracts.

[6] Escalation or redetermination must not effect contractor's earnings from V.E.

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Logistics Management Institute 4900 Massachusetts Avenue, N. W. Washington, D. C. 20016	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (Last name, first name, initial)

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
8 May 1963	164	3

8a. CONTRACT OR GRANT NO. SD-110 b. PROJECT NO. 110-6 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) 2A-2 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. AVAILABILITY/LIMITATION NOTICES

Distribution of this document is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Office of the Asst. Secretary of Defense (Installations & Logistics)

13. ABSTRACT

A study to identify the necessary elements for a joint DoD/industry value engineering undertaking was prepared for ASD (I&L), encompassing methodology, criteria, evaluation, change procedures, level of effort, organization, selection and incentives.

Evaluation by OSD of this report was made. It encompasses necessary measures to (1) reinforce DoD's already stated endorsement of the V.E. program, (2) update ASPR periodically to provide substantial financial incentives to defense contractors for successful performance of V.E., (3) develop improved training programs, (4) give wide distribution to the V.E. Handbook H-111 throughout the defense/industry complex and (5) issue a V.E. specification to establish minimum standards for performance of V.E. under program requirements clauses in defense contracts.

DD FORM 1 JAN 64 1473

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